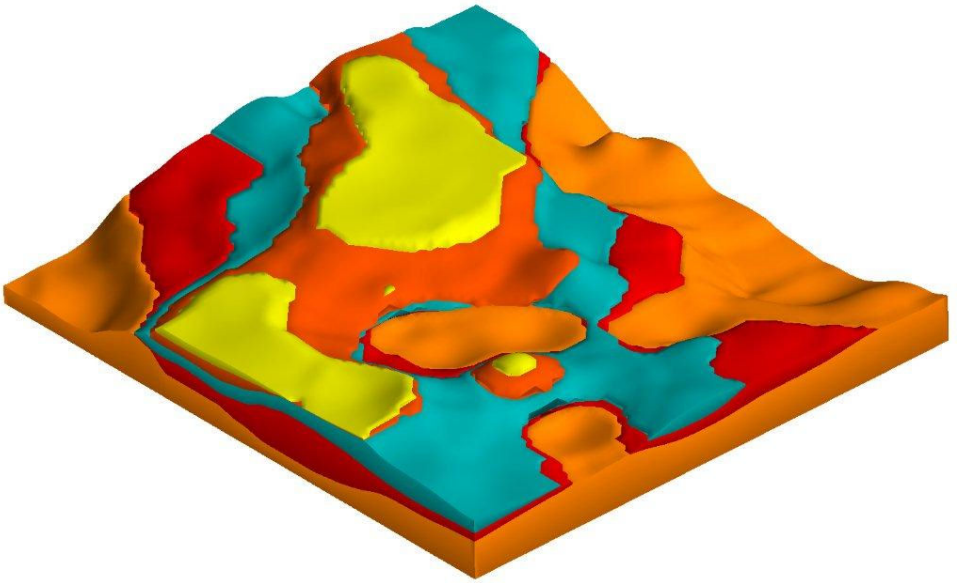
RockWorks™



RockWare ®

Earth Science & GIS Software

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Chapter 1 - Introduction

Welcome

RockWorks is an integrated software package for geological data management, analysis, and visualization. RockWorks specializes in **visualization of subsurface data** as logs, cross sections, fence diagrams, solid models, structural and isopach maps in both 2D and dynamic 3D windows.

The **borehole data manager** is used for easy entry of well data: geophysical / geotechnical / geochemical measurements, observed lithologies, stratigraphic contacts, water levels, fractures, downhole well surveys, all in linked database tables. From this data you can create point, contour, plan-view, and lithology/stratigraphy surface (geology) maps; logs; cross sections; and profiles. In addition there's an assortment of 3D diagrams: logs, surfaces, fence diagrams, and solid models.

RockWorks also contains a "flat" spreadsheet-style data window for use with the program's **RockWorks Utilities**: basic gridding and contouring, solid modeling, volumetrics, hydrology and hydrochemistry tools (drawdown & flow diagrams, Piper and Stiff diagrams), 2D and 3D feature analysis (rose and stereonet diagrams, lineation maps and densities), statistical computations and diagrams (histograms, scatterplots, ternary plots), survey mapping, coordinate conversions, and more. The RockWorks Utilities portion of the program can be purchased separately.

There are three graphic display windows in RockWorks. **RockPlot2D** displays 2-dimensional, "flat" images such as maps, logs, and cross sections. It offers save, export, and printing tools, as well as on-screen editing, drawing, digitizing and measurement tools. **RockPlot3D** is an interactive graphic display window that utilizes OpenGL for easy visualization of 3D images such as logs, fence diagrams, solid models, and 3D surfaces. It provides interactive rotation, panning, zooming, and layering of different images. Adjust lighting, filter solids, adjust colors, append images easily and quickly. View volumes instantly on the screen. **ReportWorks** is used to lay out pages for display and print. Insert RockPlot graphics (maps, cross sections, logs, diagrams, etc.) and raster images, draw scale bars and shapes, add text and legends, and more. Print and export tools take your RockWorks images to presentation stage quickly and easily.

RockWorks is available with single-user, multi-user and network licenses.

Upgrading? See also page 14 for version-specific notices. Be sure to look at the "What's New" section (page 12). All previous users should refer to "A Brief Tour" on page 18.

System Requirements

The minimum system requirements for RockWorks may vary, depending on the type of data you will be processing and the types of diagrams you will be creating and viewing. For example, a ternary diagram plot displayed in RockPlot2D and created from a simple datasheet may require fewer resources than a dense solid model manipulated in RockPlot3D and created from detailed downhole geochemistry data.

In general, the more RAM, the faster the processor, the newer the operating system, the better. Here is our recommended system setup for use of RockWorks:

Windows2000, NT, XP, or Vista.
512 MB of RAM (1GB or more recommended).
1.4 GHz or faster CPU.
Plenty of free disk space.
Display set to GREATER than 800 x 600 pixels.

Windows98 and Windows ME are not supported.

Installing RockWorks – The First Time

RockWorks can be installed either from a RockWare-supplied CD-ROM or from a file you've downloaded from our web site.

! Note that downloading the installation program from RockWare's web site is recommended since the version on the web is always the most recent build. The download page is www.rockware.com/downloads/productUpdates.php.

Install RockWorks from a CD

! Skip this step if you have already downloaded the installation program from the internet and don't wish to overwrite it with what may be an older version on the CD-ROM.

To install RockWorks from a RockWare-supplied CD, follow these steps:

1. Insert the CD-ROM into the CD-ROM drive of your computer. The CD menu program should start up automatically.

   (If it does not, use Windows Explorer to browse for the CD drive. Double-click on the "setupcd" program in the root of the CD to start up the CD menu program.)

2. The CD menu program will display a variety of different programs that you can install as demos or "trialware" in addition to RockWorks. For now, however, simply select RockWorks from the menu along the left. You should see a description about the program in the pane to the right. Click the ***Install Program*** button in that pane to start the installation.

3. Follow the recommended installation settings unless you specifically to install the program in a different folder. To proceed to the next screen at each installation step, click on the ***Next*** button. Should you need to go back to a previous window, click on the ***Back*** button. To cancel the installation entirely, click ***Cancel***.
4. When the installation is complete, the licensing program will start up automatically. Refer to Licensing RockWorks (page 4) for information about how to set up the licensing.
5. If you have purchased the software, please fill out the registration card for your license, or register online at http://www.rockware.com/support/register.php.

The Searchable Help system is installed with the program.

Install RockWorks from the internet

If you wish to download and install RockWorks from the internet, follow these steps:

1. Access the RockWare web site: www.rockware.com
2. Click on the "Downloads" option at the top of the home page, and choose Product Updates.
3. Click on the RockWorks link, and under the RockWorks14 item, click the small “Download” link.
4. When requested, save the downloaded file (“rockwork14_installation.exe”) on your computer’s Desktop (or other desired location).
5. When the download is complete, click the browser’s Run or Open button, or simply use Windows Explorer or My Computer to locate the downloaded file, and double-click on this “rockworks14_installation.exe” file. This will start up the RockWorks installation program.
6. Follow the recommended installation settings unless you specifically to install the program in a different folder. To progress to the next screen at each installation step, click on the ***Next*** button. To go back to a previous window, click on the ***Back*** button. To cancel the installation entirely, click ***Cancel***.
7. When the installation is complete, the licensing program will start up automatically. Refer to page 4 for information about how to set up the licensing.

Re-Installing RockWorks

RockWare releases updates to the RockWorks program when new features are added, problems are fixed, etc. These new revisions are posted to our web site. They’ll also be included on the next pressing of the RockWare CD. Like the original program, the updates can be installed from a CD or from an internet download.

To re-install RockWorks, you should follow the same instructions as listed in the previous two topics for step-by-step instructions about installing. You can install right over the top of the existing copy of the program.

! If this a re-installation, the program will automatically create backup copies of existing program reference tables and libraries in \My Documents\RockWorks14\ System. Be sure to check that folder after installation to restore necessary tables.

Re-installing RockWorks does not require un-installing the previous version. In fact, we discourage this because system libraries and other tables will be removed.

Re-installing should not require a new unlocking code for single user or multiple-user/single computer licenses.

During re-installation, all of the program's variables (e.g. all of the menu settings) are restored to the factory default versions. However, the program will offer to save a copy of your menu settings in a file which you can then import back into the program (**Tools** / **Import Menu Settings**).

Check out the **Help** / **Download & Install** options in RockWorks itself.

Licensing RockWorks

After running the installation program, the next step is to license the software.

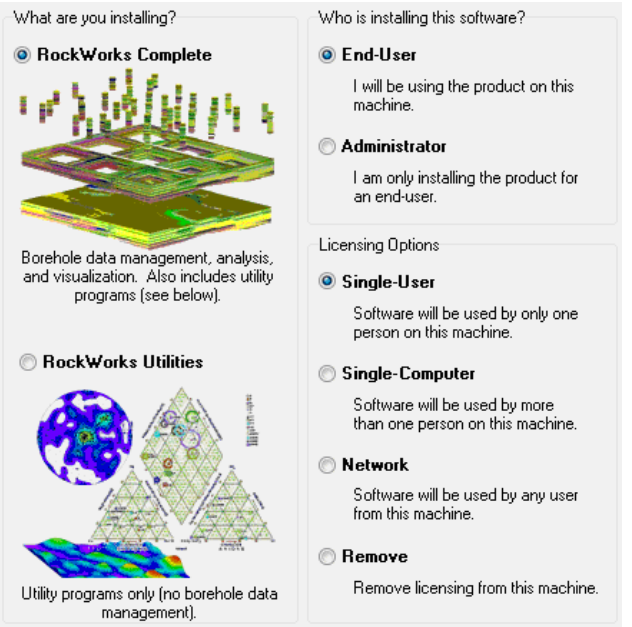
The License Agreement

The first screen you'll see is a display of the license agreement. Please read this. It's important that you understand the terms of the license.

1. If you accept the terms of the license agreement, click in the ***I accept the terms of this agreement*** box, and continue on to the next step.
2. If you do not accept the terms of the license agreement, click the ***Cancel*** button. The program will not launch. Contact RockWare for details.

Choosing Your License Type

Next, you'll see a screen similar to this:


What are you installing?
RockWorks Complete
Borehole data management, analysis, and visualization. Also includes utility programs (see below).
RockWorks Utilities
Utility programs only (no borehole data management).
Who is installing this software?
End-User
I will be using the product on this machine.
Administrator
I am only installing the product for an end-user.
Licensing Options
Single-User
Software will be used by only one person on this machine.
Single-Computer
Software will be used by more than one person on this machine.
Network
Software will be used by any user from this machine.
Remove
Remove licensing from this machine.

1. First, choose ***RockWorks Complete*** if you have purchased the full RockWorks program. Choose ***RockWorks Utilities*** if you have purchased that portion of the program only.
2. Next, you need to specify who you are: click in the ***End User*** button if you will be using the software. Click in the ***Administrator*** button if you are installing the software for someone else. This makes a difference in the licensing process:

   You must be the ***End User*** to unlock a Single User license.

   You must be an ***Administrator*** or an ***End User*** with standard user or higher privileges (e.g. administrator) to unlock the Multi-User license or to set up the Network license.
3. Now, select the type of license you have purchased. There's more information about the license types displayed in the right pane of the program window.

   Single User: If you purchased a Single User license, click that button. With this license type, RockWorks is licensed to be used by a single designated person. You should purchase this license type if you will be the only user of the program. Running in this mode requires an "unlocking code" that is supplied by RockWare. If you purchased a Single User license, your registration number (on a sticker on your CD or user manual) will contain the letters CS or AS. If you are waiting to receive

your unlocking code, can run the program in "Trialware" mode (see below).

! If you are an Administrator (installing the program for another person), you will need to cancel the licensing at this time and have the actual user log into the computer. The Single User licensing information is stored under the Current User registry. The actual user can rejoin this licensing sequence by starting up the RockWorks application after they've logged into Windows.

Single Computer: Use this mode if you have purchased a Single Computer license for the program. With this license type, RockWorks can be installed onto a single computer and used by multiple people on that computer, one at a time. You should purchase this license type if more than one person will need to access the program on the computer, such as in an academic lab where multiple students will need to use the software. If you purchased a Single Computer license, your registration number, on a sticker on your CD or user manual, will contain the letters CM or AM. Running in this mode requires an "unlocking code" that is supplied by RockWare.

Network: Click in this button if you have purchased a network license for the program, which allows more than one person to access the program at the same time. If you purchased a Network license, your registration number, on a sticker on your CD or user manual, will contain the letters CN or AN. The network version requires a special network license certificate file, which RockWare will email to you. This file must be stored on the server in a location to which all users have access.

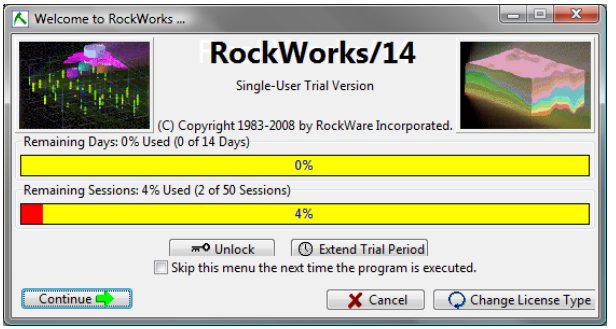
Trialware: If you haven't purchased a license yet and wish to run in "Trialware" mode, choose ***Single User***. In Trialware mode all program functionality is intact except some of the export tools are disabled. You *can* input your own data, import data, create graphics, etc. In Trialware mode, you are allowed to use the program for 14 days from licensing or for 50 launchings, whichever comes first. You will see the usage/time meter on the startup screen. Trialware mode can be converted to a Single User license by entering a RockWare-supplied unlocking code. Trialware mode can also be extended if you contact RockWare.

4. Click ***Continue*** when the user and license type have been selected.

The program will now copy sample and system files to a RockWorks14 folder in My Documents. It will also initialize all of the program's variables.

Single User Mode, Running in Trial Mode / Unlocking

Single Users will now see a window that displays the number of user sessions and days remaining.



1a. To use RockWorks in Trial mode, click the ***Continue*** button. (See Starting Up, page 9.)

1b. Or, if you are ready to license your program (or if your trial period displays as expired), you can unlock the software by clicking on the ***Unlock*** button and entering the following information.

! PLEASE BE SURE that, to unlock the program, you are the end user and are logged into Windows under your normal Windows login.

Registration Number: Type into this field the letters and numbers that are printed on a sticker on the CD, User Manual, and registration card you received from RockWare.

Single-User registration numbers contain the letters CS or AS. If you opted to downloaded the program at purchase, you can contact RockWare for this number.

Licensee Name: Type in your company's name or your name, if purchased individually. This will be displayed in the program's startup screen.

Installation Number: This is a number that's generated by the RockWorks program when it's first started. It is unique to each computer and each user.

Unlocking Code: This activates the Single-User license and is supplied by RockWare when you send us your Registration Number and Installation Number, described above. Contact RockWare as described on page 9.

2. You can click ***OK*** to proceed, and jump to page 9, Starting Up RockWorks.

Single Computer License, Unlocking

Note: You must have standard user or higher privileges (e.g. administrator) to unlock the Single Computer license. Restricted users should contact their system administrator.

Single Computer licensees will now see a window where the licensing information can be entered.

1. Enter the requested information.

   Licensee Name: Type in your organization's name. This will be displayed in the program's startup screen.

   Registration Number: Type into this field the letters and numbers that are printed on a sticker on the CD, User Manual, and registration card you received from RockWare.

   Single Computer registration numbers contain the letters CM or AM. If you opted to downloaded the program at purchase, you can contact RockWare for this number.

   Installation Number: This is a number that's generated by the RockWorks program when it's first started. It is unique to each computer.

   Unlocking Code: This activates the Single Computer license and is supplied by RockWare when you send us your Registration Number and Installation Number, described above. Contact RockWare as listed on page 9.

2. You can click ***OK*** to proceed, and jump to page 9, Starting Up RockWorks.

Network User, Logging In

Note: You must have standard user or higher (e.g. administrator) privileges to set up the network licensing. Restricted users should contact their system administrator.

Network licensees will now see a window where their licensing information can be entered.

1 Enter the requested information.

   Licensee Name: Type in your company's name. This will be displayed in the initial splash screen.

   Registration Number: Type into this field the letters and numbers that are printed on a sticker on the CD, User Manual, and registration card you received from RockWare. Multi-User registration numbers contain the letters CN or AN. If you opted to download the program at purchase, you can contact RockWare for this number.

   Certificate File: Use the Browse button to access the folder in which the network's certificate file "RW14.LIC" has been installed. This is a file that is supplied by RockWare after your purchase, initialized for the number of seats you purchased. You may not run the network version of RockWorks without access to the Certificate File which maintains the network count, among other things. To obtain the certificate file, contact RockWare as shown below.

   When you/your network administrator receives the certificate file via email, save the file to a folder on the server to which all users have read and write access.

2. You can click ***OK*** to proceed.

Contacting RockWare Inc.

To obtain Single User or Single Computer unlocking codes, or your network certificate file, contact RockWare by:

web: Visit www.rockware.com/support/unlock.php.

Telephone:
within Colorado: 303-278-3534
within the U.S.: 1-800-775-6745
outside the U.S.: + 303-278-3534

Fax: + 303-278-4099

You will need to include: * Your name, * Your company's name (if applicable), * The Registration Number, * The Installation Number (for unlocking codes only), and * How we should contact you (email, telephone, or fax).

Starting Up RockWorks

Starting RockWorks the First Time

After you have installed the program as described in the separate topic (page 2), and you have licensed the program as described in the previous topics, the program will now display an introductory startup screen that lists your license name and registration number.

1a. Single Users and Single Computer: If you wish to hide the splash screen upon future launchings, insert a check in the ***Skip this menu the next time the program is started*** check-box, or (once RockWorks has launched) use the **Tools** / **General Preferences** / ***Skip Intro Screen*** setting.

1b. Network users only will be prompted to enter:

Default User ID: This is typically your name or other unique identifying string. The ID string is limited to 20 characters, including spaces. Your ID will be stored in the network Certificate File while you are using the program. When you exit RockWorks using the program's **File** / **Exit** command, your ID will be logged out of the Certificate File. The Certificate File will allow a specific number of unique users to log in at a time; for example if you purchased a 5-seat license, then 5 unique ID's are allowed to be logged in at any one time.

2. Click ***Next*** to continue.

The program will be displayed, loading the default "Samples" project database. RockWorks contains two separate data windows, with separate sets of tools: The Borehole Manager is used for entering/managing borehole data, and the RockWorks Utilities Datasheet is where you enter more general types of data.

4. To access either data window, just click on its tab, displayed along the left side of the

program window.

You will also see a Help window pop up onto the screen. This contains information about entering data and the use of the program. It also contains tutorial lessons – look for the Tutorial button at the top of the window, or the Tutorial heading in the table of contents. We highly recommend that you go through some of these lessons to acquaint yourself with how RockWorks works. The Help window will display each time the program starts; you can turn it off using the **Tools** / **General Preferences** / ***Show Help Messages on Startup*** setting. You can also access the Help window at any time using the **Help** / **Contents** option, or by clicking the Help button in the program windows.

You can click on the ***Project Folder*** = item near the top of the program window to open a different project folder or create a new project folder.

See Getting Started Checklist (page 25) for some important tips regarding the Borehole Manager.

Starting RockWorks the Next Time

If you've already installed and run RockWorks before, follow these steps to start up the program.

1. Click on the Start button on the Windows taskbar.
2. Click on the Programs or All Programs option.
3. Click on the RockWare group, and then on the RockWorks 14 program icon.

If you have hidden the startup screen, you will be prompted to choose this session's project folder – see #5 below.

If you have not hidden the startup screen, it will be displayed, showing your current license type, registration number, and licensee name.

If you are running the program in "Trialware' mode, you will see the number of sessions and the number of days you have left in your trial period. If RockWorks has been run before on this computer, the uses and/or days may be used up. This can be true even if you had uninstalled the software before re-installing. If you need more time, contact RockWare and we may be able to provide an "extension code."

4. If you want to continue with the current license type, click the ***Next*** button.

   If you need to change your license type, such as changing from Single-User to Multiple User, click the ***Change Licensing*** button and follow the instructions below.

The main RockWorks program window will be displayed.

Changing the Licensing

If you wish to change the type of license under which RockWorks is being run, you'll need to contact RockWare to make the necessary arrangements. Then, you'll click on the Change License Type button on the introductory screen. This will launch the RockWorks

licensing program and display the screens described in the topics above. The RockWorks licensing program can also be run from the Start / Programs / RockWare menu.

Uninstalling RockWorks

If you own a Single User or Multiple-User / Single Computer license of RockWorks and you want to install your license on a different computer, you'll need to remove the program from the original machine. Follow these steps to remove the RockWorks licensing and program from your computer:

Step 1: Remove the licensing from your computer.

1. Start up the RockWorks program.
2. At the initial startup screen, click ***Change License Type***. (This screen can also be accessed by running the RockWorks Licensing program in the RockWorks program folder or via Start / Programs / RockWare.)
3. At the RockWorks Licensing Options screen, click the ***Remove*** licensing button at the bottom of the window.

The program will prompt you to confirm this.

4. Click Yes.

The program will remove all RockWorks licensing from your computer. It will also display a Status Code.

5. Write down the Status Code that is displayed; RockWare employees may ask you for this number to verify the license removal.

Note that this license removal does not affect the Trialware day/use counter.

Step 2: Copy data/reference files to the new computer.

Be sure you've copied any necessary project folders to the new computer. You should also refer to the My Documents\RockWorks14\System folder for any reference libraries (patterns, symbols, etc.) that you may have modified and should copy to the new computer.

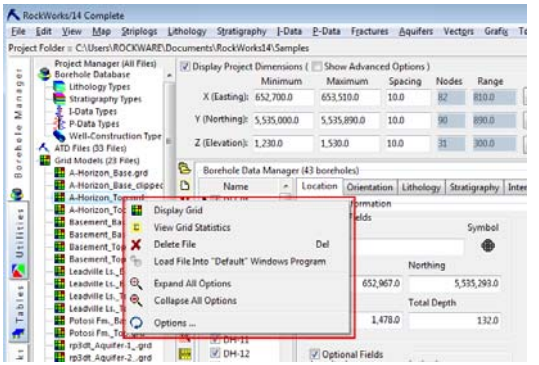
Step 3: Remove the program itself.

1. Access the Windows Control Panel: Click on the **Start** button on the Windows taskbar. Click on the Control Panel option (Windows XP, Vista) or first on the **Settings** item and then on **Control Panel** (Windows2000).
2. Double-click on the **Add/Remove Programs** icon.
3. Locate the RockWorks/14 item in the program list.
4. Select the ***Change/Remove*** or ***Remove*** option, depending on your version of Windows.

Windows will launch its remove-software program. It will offer you either ***Automatic*** or ***Custom*** removal. We generally recommend following the ***Automatic*** removal, as this will remove the program files from your computer, but will not touch any of your own data files.

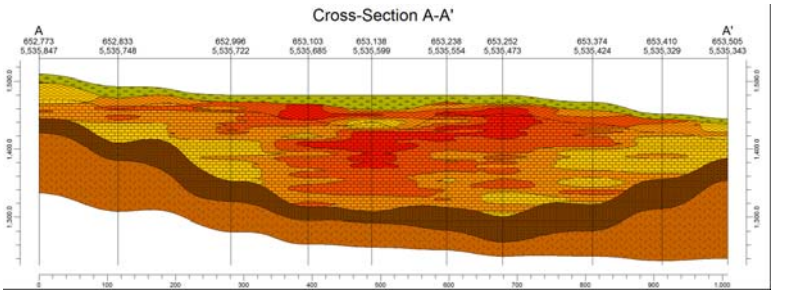
What's New in RockWorks/14

Use the new Project Manage to view and open files in the current project folder.

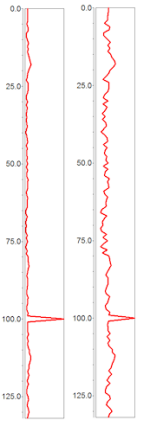


- Customize the types of files that are displayed.
- Double-click on grid model names to display them as 2D contour maps or 3D surfaces.
- Double-click on solid model names to display them as 3D voxel or isosurface models.

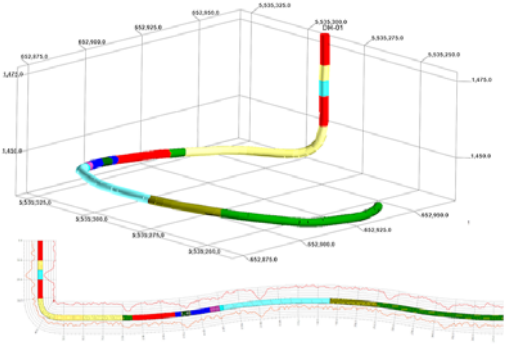
Plot lithology patterns in 2D sections and profiles, such as this overlay over a Stratigraphy section:



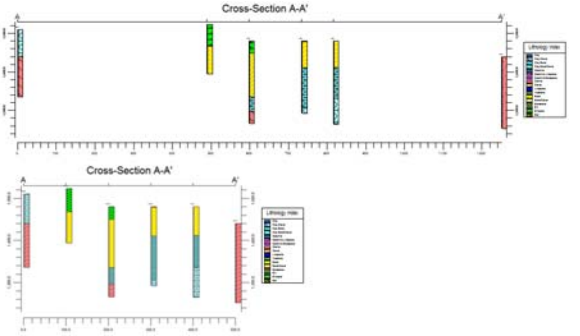
Plot I-Data and P-Data using logarithmic scales in 2D and 3D logs.



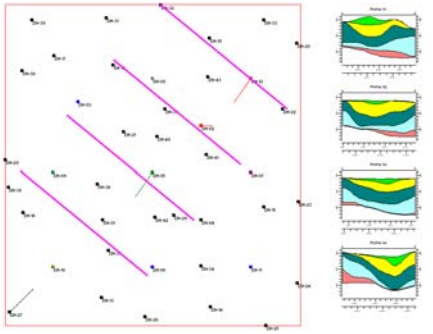
"Unwind" directional logs to avoid projection onto themselves



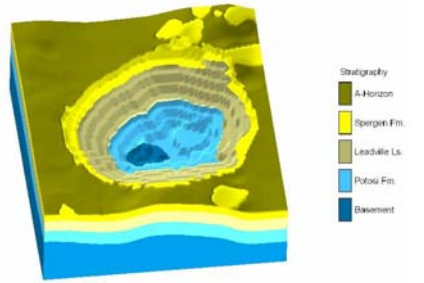
Equal-spacing of logs in multi-log sections – helpful for section with long gaps between boreholes:

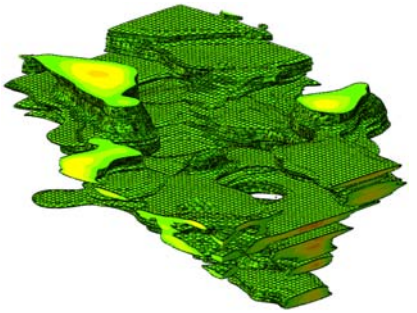


Plot multiple parallel profiles automatically:



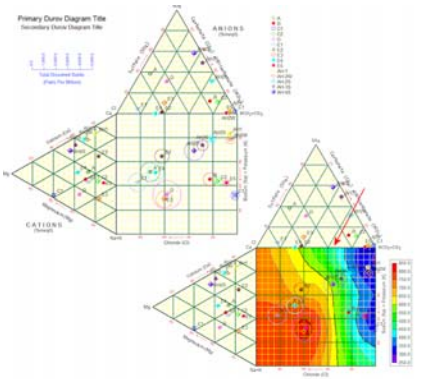
Plot side panels in clipped stratigraphy diagrams ->





Include "isomesh" contour lines in 3D isosurface diagrams:

Plot hydrochemistry data as Durov diagrams, with optional density or TDS color contours



And much more.

- See Help / Contents / Introduction / What's New in RockWorks
- See **Help** / **Online Information** / **RockWorks Revision History**

RockWorks2006 Users Read This

There should be a seamless transition between RockWorks2006 and RockWorks14 – the Borehole Manager database and the RockWorks Utilities ATD files, grid and solid models, and all graphics files created in RockWorks2006 are fully compatible with RockWorks14. The program will be installed into a new folder, and a new "RockWorks14" Samples and System folder will be created in My Documents (WinXP) or Documents (Windows Vista) folder.

RockWorks2004 and 2002 Users Read This

RockWorks borehole data is now stored in an Access MDB file. When you browse to an existing project folder, an Import Wizard will launch automatically, leading you through a few simple steps to import your .BH files, lithology table, and stratigraphy table into the database.

Lithology and Stratigraphy Tables are stored in the project database – they are no longer stored in external "TAB" files. Because these "Type" tables are linked to the lithology and stratigraphy data tables, you can't list a material or formation for a borehole that is not defined in the Type table.

The new Well Construction data table has the same kind of Type table to which it is linked.

All other reference tables (TAB), Utilities datasheets (ATD), models (GRD, MOD), and graphics (RKW, XML, RWR) should be fully usable in RockWorks14. Note that RockPlot2D "RKW" files will be updated to the newer "RK6" format upon opening, and ReportWorks "RWR" files will be updated to the newer "RW6" format upon opening.

Experiment with the new editing capabilities of the RockPlot2D window – you can click and drag graphic objects, double-click on objects to change their properties, and insert additional text, shapes, legends, images into the image.

Please see the What's New section, just previous, for more information about the new version.

RockWorks99 Users Read This

Your Data

If your RockWorks99 ATD files contain downhole stratigraphy and/or linked downhole data files (LIT, HIS, CUR, ZON files) you will now work with your data in the Borehole Manager, the new data window. See Borehole Manager Overview (page 30) and Importing RockWorks99 Files (page 54) into the Borehole Manager.

If your ATD files do not represent borehole data, you will continue to use the RockWorks Utilities datasheet. The information in your template (TEM) file will now be stored as a header in the ATD file, so you won't have to manage two files. See the RockWorks Utilities Datasheet Overview (page 73) and Opening a RockWorks99 datasheet (page 76).

Your Plots

If you have existing "RKW" files containing RockWorks99 images, you can still open these into RockWorks14. Use the **RockPlot2D** button (left side of screen) to open a RockPlot2D window, and use its **File** / **Open** command to open existing RKW images.

They will be updated to the new graphic format automatically, and you can save the updated versions under a new file name.

RockWorks14 also contains an OpenGL 3-D plotting window: **RockPlot3D** (see page 225). This is the window that will be used to display any new 3D images you create, such as 3D log displays, fence diagrams, solid models, and 3D surfaces. You cannot open RK6 files in the RockPlot3D window.

There is a built-in **ReportWorks** program used for laying out pages for print and display – include RockWorks images, bitmaps, shapes, text, and legends. See page 241 for information about ReportWorks.

Other New Features

The Borehole Manager allows entry of downhole survey measurements for **deviated or inclined borings**.

LogPlot Users Read This

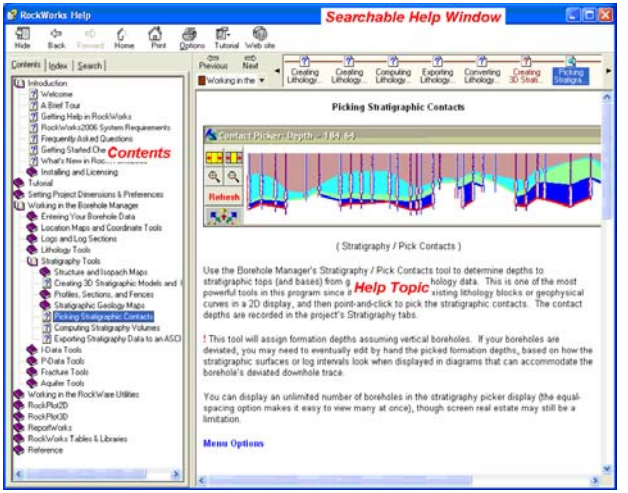
RockWorks14 contains a LogPlot Import program that functions as a batch importer of multiple LogPlot DAT files into the RockWorks MDB database. Using either log design or DAT file information, this tool can determine the LogPlot entities that can be imported into RockWorks, and, where possible, it will offer the user control over the specific import options. Lithology / stratigraphy data (LogPlot: "LITH"), geochemical data (LogPlot "Histogram"), geophysical data (LogPlot "Curve"), log symbols, text, and well construction information can be imported. Once imported into RockWorks, the user has a variety of program tools at hand: strip logs, cross sections, solid models, surface maps, and more.

See Help / Contents / Borehole Manager / Entering Your Borehole Data / Importing Data from Another Source for more information.

Getting Help

The following documentation and help resources are available for the RockWorks program:

Built-in help system:

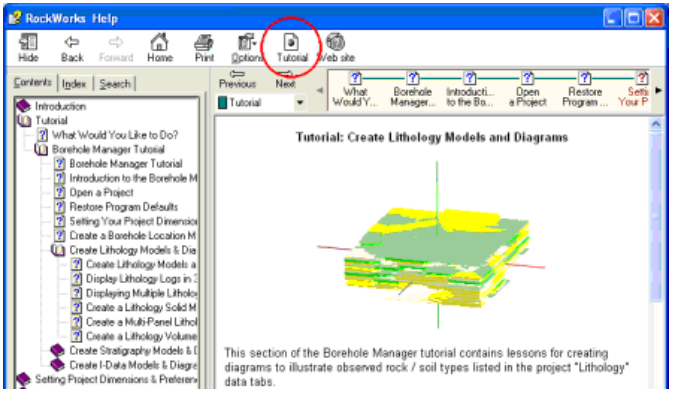


Complete program information is installed in a single "Searchable Help" file that offers a table of contents, index, and advanced searching tools. This help is available via:

- Help / Contents (main menu)
- (options windows)
- F1 key (most windows).

Throughout the RockWorks documentation look for the symbol to know where to look for more information in the Searchable Help system.

On-line tutorial:


RockWorks Help
Tutorial
Contents
Index
Search
Tutorial: Create Lithology Models and Diagrams
This section of the Borehole Manager tutorial contains lessons for creating diagrams to illustrate observed rock / soil types listed in the project "Lithology" data tabs.

The tutorial lessons are included in the main Help system. You can access them using the Contents tab in the left pane of the Help window, or by clicking on the Tutorial button at the top of the window.

Web Support Page: Visit www.rockware.com and click on the Support menu for a variety of support options, including FAQ's, case studies, etc.

Web Support Forum: Join our user forum at www.rockware.com/forum/index.php - you can post questions, read existing postings, search on keywords, and more.

User Manual: The user manual is designed to be a "roadmap" to summarize program functions and to direct you to other resources for more information. The manual can be downloaded (PDF format) from www.rockware.com, and click on the Support / RockWorks / Downloads / Documentation menu item.

Contact RockWare: If you own a registered * RockWorks license, you are eligible for 1/2 hour of free telephone support and free email support, both subject to change. Technical questions can be emailed to: tech@rockware.com. The support telephone number is 303-278-3534, and listen to the switchboard menu for support. Technical staff hours is typically 9 – 4 (Mountain time zone). Our mailing address is: 2221 East St, Suite 101, Golden, Colorado 80401 USA. When you contact us, please be sure to include the revision number of the program (visible in Help / About), the version of Windows you are using, what you are trying to do in the program, and whether you are seeing an error.

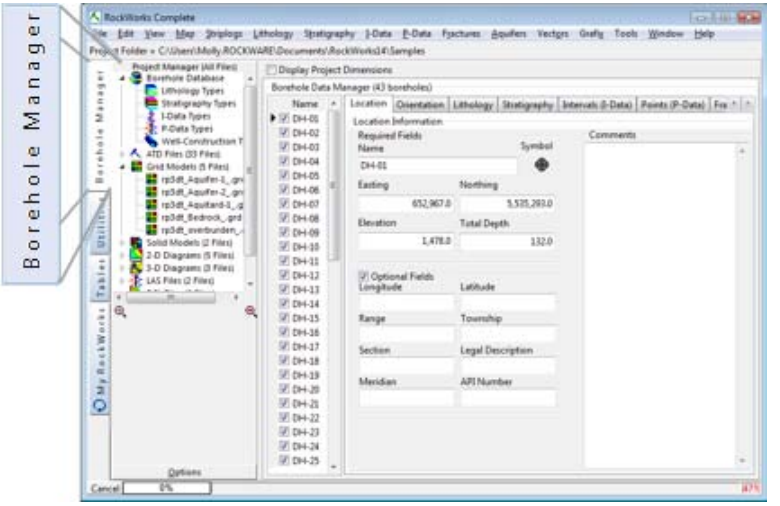
Critical errors now generate a "bug report" that can be automatically sent to the RockWare support staff. This report keeps us from asking a bunch of obnoxious questions about your machine configuration and exactly where the bug occurred.

* To register your license, mail in your yellow registration card or visit www.rockware.com/support/register.php.

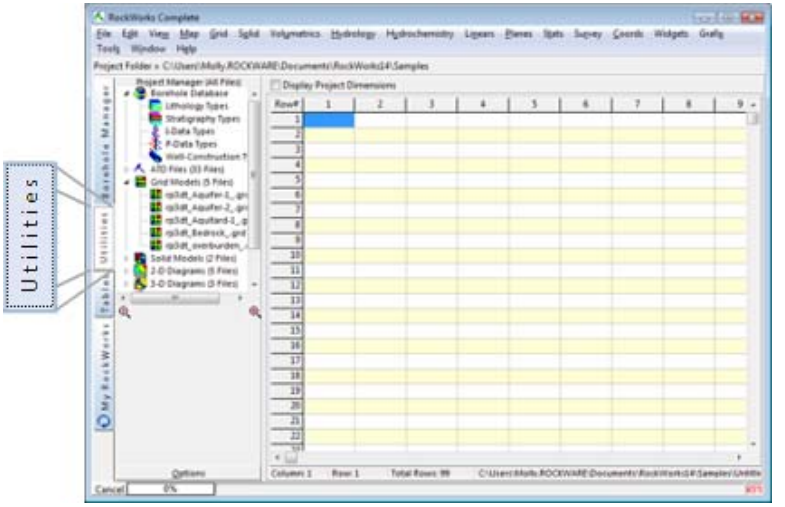
A Brief Tour

Here are some important landmarks within RockWorks:

1. **The Borehole Manager**: This is the data window and suite of menus for entering and working with borehole data. Here is where you do most of the sub-surface modeling and visualization in RockWorks: 2D and 3D logs, cross sections, fence diagrams, solid models, stratigraphic models, structure maps, etc. Borehole data is stored in an Access (MDB) database. You can access the Borehole Manager using its tab along the left edge of the program window.

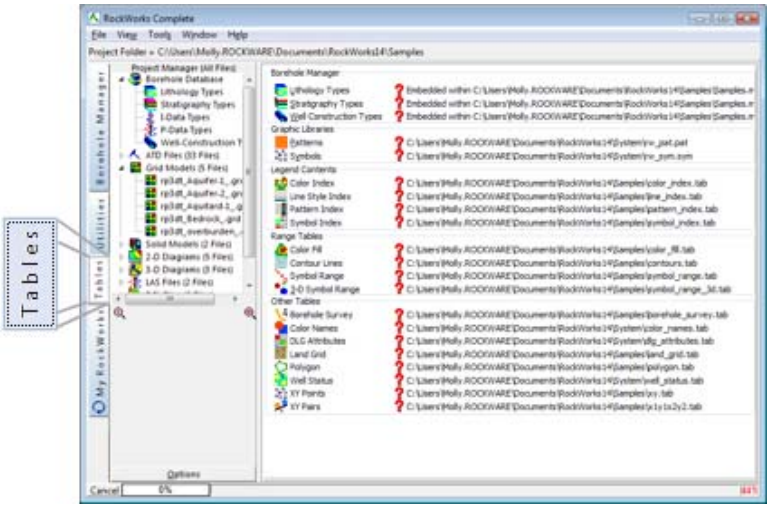


2. **The RockWorks Utilities**: This is a simpler, row-and-column type of data window with its own suite of menus. Here you can create many different types of maps, charts, and diagrams. Even if you are working primarily with borehole data, you will still use many of the tools in the RockWorks Utilities for analytical work (statistical analysis, grid & solid model math/filtering tools, etc.). You can access the Utilities window using its tab along the left edge of the program window.

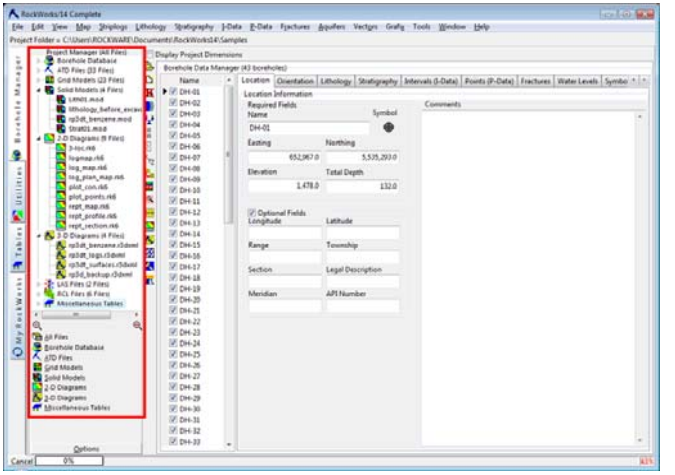


3. **Tables**: Use the "Tables" tab along the left edge of the program window to access a listing of program libraries that you'll use a lot in the Borehole Manager and from

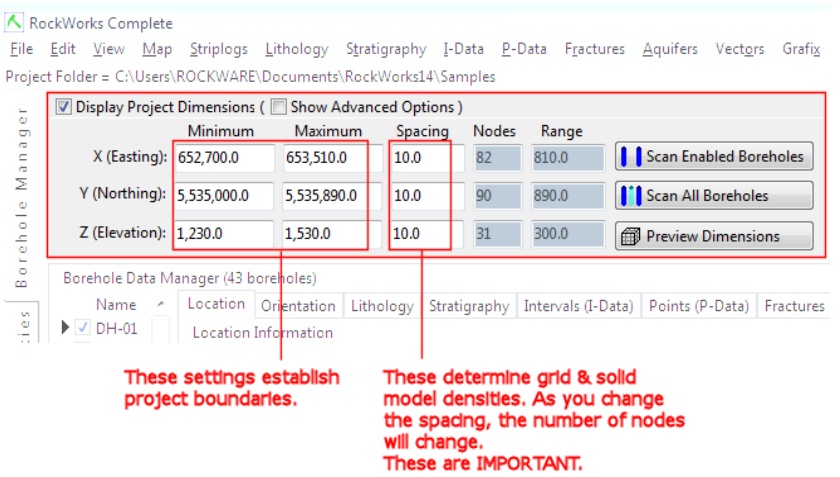
time to time in the RockWorks Utilities: Lithology and Stratigraphy Types Tables for modeling downhole lithology types and formations; pattern and symbol libraries for maps, logs, and cross sections; coordinate tables for polygon-clipping; look-up tables for customized symbols and contours; and more.



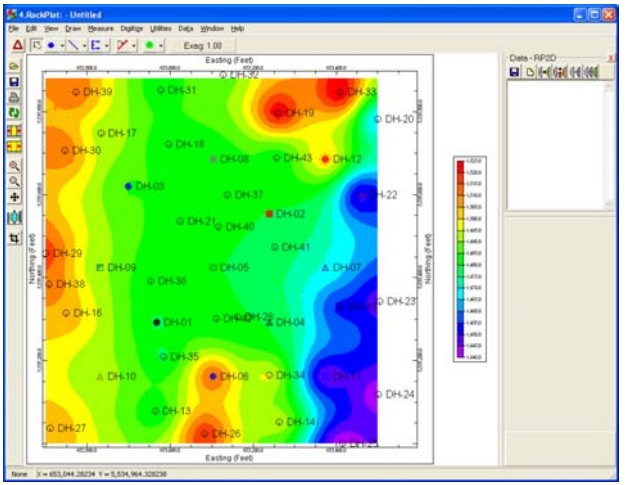
4. Project Manager: This pane, along the left edge of the program window, displays RockWorks files that reside in the current project folder, and tables in the project database, for quick and easy access: Hover over graphic files to see previews, double-click on files to open them, configure which files to display, if any.



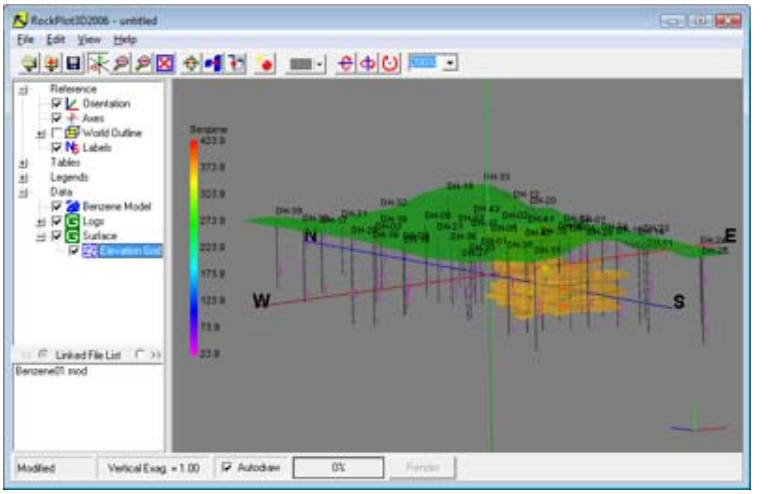
5. **Project Dimensions**: Here you establish the boundaries of your working project, for both borehole-related and general data, for consistency in modeling and boundary annotations.


RockWorks Complete
File Edit View Map Striplogs Lithology Stratigraphy I-Data P-Data Fractures Aquifers Vectors Grafix
Project Folder = C:\Users\ROCKWARE\Documents\RockWorks14\Samples
Borehole Manager
Display Project Dimensions (Show Advanced Options)
Minimum Maximum Spacing Nodes Range
X (Easting): 652,700.0 653,510.0 10.0 82 810.0
Y (Northing): 5,535,000.0 5,535,890.0 10.0 90 890.0
Z (Elevation): 1,230.0 1,530.0 10.0 31 300.0
Scan Enabled Boreholes
Scan All Boreholes
Preview Dimensions
Borehole Data Manager (43 boreholes)
Name Location Orientation Lithology Stratigraphy Intervals (I-Data) Points (P-Data) Fractures
DH-01
Location Information
These settings establish project boundaries.
These determine grid & solid model densities. As you change the spacing, the number of nodes will change.
These are IMPORTANT.

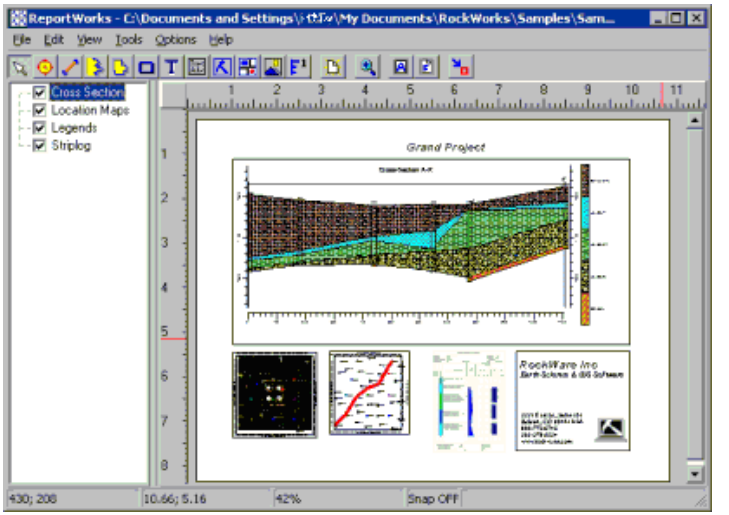
6. **RockPlot2D**: This is the window in which 2D (flat) maps, logs, and diagrams are displayed. This window is displayed automatically each time that a 2D graphic is generated. You can also open a blank RockPlot2D window using the File / RockPlot2D menu option.



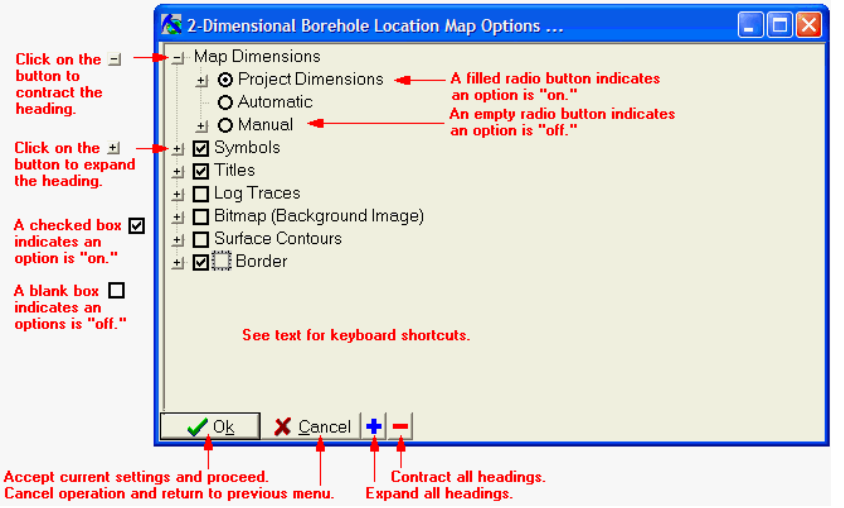
7. **RockPlot3D**: This is the interactive window in which 3D images are displayed (surfaces, solids, 3D logs, fence diagrams, and more.) This window is displayed automatically any time that a 3D graphic is generated. You can open a blank RockPlot3D window using the File / RockPlot3D menu option.



8 **ReportWorks**: This is the page layout program for RockPlot2D images and bitmaps, with legend, text, shape, scale bar annotations.



9. **Menus and Options Windows**: Most of the RockWorks tools are accessed by clicking on the toolbar buttons and/or by clicking on the drop-down menus at the top of the program windows and selecting an item from the menu's list. When a menu item or button is selected, a window with program options will be displayed. The options will be displayed in an expandable/collapsible outline format.


2-Dimensional Borehole Location Map Options ...
Map Dimensions
Project Dimensions
Automatic
Manual
Symbols
Titles
Log Traces
Bitmap (Background Image)
Surface Contours
Border
Ok
Cancel
Click on the button to contract the heading.
Click on the button to expand the heading.
A checked box indicates an option is "on."
A blank box indicates an options is "off."
A filled radio button indicates an option is "on."
An empty radio button indicates an option is "off."
See text for keyboard shortcuts.
Accept current settings and proceed.
Cancel operation and return to previous menu.
Contract all headings.
Expand all headings.

Use your mouse to expand/collapse headings and select items as described in the picture. If you prefer to use your keyboard, here's a list of shortcuts:

+	Expands the current node (equivalent to clicking on the "+" button).
-	Collapses the current node (equivalent to clicking on the "-" button)
CTRL+ENTER	Opens the current node's edit dialog (equivalent to double-clicking)
SPACE	Changes the state of a checkbox or radio button (equivalent to a single click in a checkbox or button).
Up and Down Arrows	Selects the next or previous node.
Tab	Moves from the menu options to the OK/Cancel toolbar to the Help toolbar.
ENTER	Accepts settings and moves on to next step (equivalent to clicking the OK button)
ESCAPE	Cancels the dialog (equivalent to clicking the Cancel button)

Right-click	Right-click on any of the nodes to view the behind-the-scenes menu name, group name, and parameter (variable) name. This information can be helpful if you are writing RCL scripts.

Scripting RockWorks

RockWorks can be run using "RCL" (RockWare Command Language) scripts, either from a program command line or using the File / **Compile RCL** menu option.

? Help / Contents / Reference / RCL Scripting.

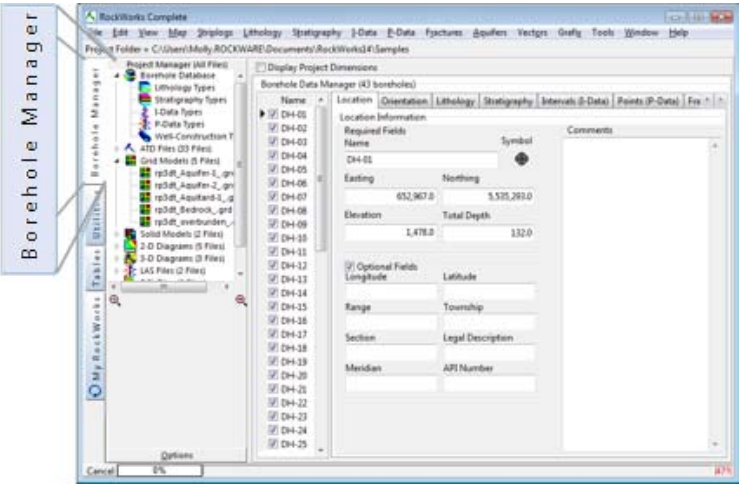
Chapter 2 - The Borehole Manager

Using the Borehole Manager

The Borehole Manager is the RockWorks data interface designed for entering downhole data. It is one of two main data windows available in RockWorks.

How to access the Borehole Manager

1. Click on the large Borehole Manager button along the left side of the program window.



The program will bring the Borehole Manager window to the front.

! The menu items at the top of the window will change depending on which data entry program is currently activated. The Borehole Manager and the RockWorks Utilities datasheet each has its own suite of menus and program options.

Getting Started Checklist

Here is a checklist of items to remember when working with the RockWorks Borehole Manager.

1. When you're starting a new project, launch RockWorks and create a new project using **File / New Project**. When you create a new project in RockWorks, you'll be creating two new items on your computer: A new folder, with the name of the project, and a new .MDB file inside that folder, with the same name. (Page 27.)

- Borehole data for each project is stored in a Microsoft Access database or MDB file.
- Each project has its own database in its own project folder. Models and graphics are stored in the project folder, too.
- The database file and the project folder share the same name ("SmithProject" folder would have the "SmithProject.mdb" database file).

2. Once the project is created, you can **enter your data**.
   - You can import your borehole data from Excel files, and other formats. (Page 52.)
   - You can also hand-enter the borehole data. Use **File** / **New Log** to add a new borehole record. The Location tab is required for each borehole. (Page 31)
   - Enter the downhole data into the appropriate data tab for the well. (Page 39)
   - Use the **Edit** / **Edit Data as Spreadsheet** as a neat tool for spreadsheet-style editing of a table, including copy/pasting, etc. (Page 51)
   - Quick **database shortcuts**: Tab advances cell to cell. Ctrl+Del deletes a row. Down-arrow adds a row to the end of the table. Right-click/Rows to add or delete a row.
3. When your borehole data is entered/imported, be sure to establish the **project dimensions**. (Page 69)
   - This is easily done by scanning all/enabled boreholes using the buttons.
   - If you'll be creating surface or solid models, be sure the project dimensions' node #s are dense enough (but not too dense!) to properly represent your data. Use the Preview Dimensions button to get an idea of how dense the model will be.
4. Remember that lithology materials, stratigraphy formations, and well construction materials link to respective **"Types" tables**. (Page 253)
   - The formations in the Stratigraphy Types Table must be listed in order from the ground downward for proper modeling to take place.
   - In the Lithology and Well Construction Types Tables, any extra material types can be omitted from diagram legends.
   - Since only the pattern's background color is used for lithology in 3D logs, models, and fences, be sure to choose something other than white for all of your formations and materials.
5. Use the database query tools to enable borehole subsets for modeling and display. There is a simple query and a complex query available. (Page 67)
6. Before you start creating interpolated models of your data, first create a graphical representation of the data as entered (e.g. as **logs**). The 2D and 3D log designers

make it easy to select what kind of data to display in the logs, and the column order. (Page 117)

- Striplogs / Multi-Log 3D tool - see the data as entered for all of the boreholes.
- Striplogs / Multi-Log Section - see the log data in a hole to hole cross section.
- Striplogs / Multi-Log Profile - see the log data in a projected section.

7. When you're ready to **interpolate** surface models (Stratigraphy, Water Level) or solid models (Lithology, I-Data, P-Data, Fractures), remember that the Model, Profile, Section, Fence, Plan, and Surface Map options can all utilize the same interpolated numeric model. Once you generate a model that looks good, you can select the Existing Existing Model option to generate the other diagram types. They simply offer different ways to visualize the contents of the interpolated model. For this reason, many users find that using the Model option first, to create the numeric model and to visualize it in 3D, is a good way to check the accuracy of the interpolation. They then use that existing MOD file as the basis for other diagrams – sections, fences, profiles, etc.
8. **RockPlot2D** is the display window for 2D (flat) graphic images such as maps, cross sections, 2D logs, rose diagrams, and the like. It contains editing tools (page 207).
9. **RockPlot3D** is the display window for 3D graphic images, such as solid voxel models, isosurfaces, fence diagrams, 3D surfaces, etc. It is interactive, with rotation, zooming, appending, etc. (Page 225.)
10. **ReportWorks** is a page layout window for images (RK6, BMP, JPG, TIFF, etc.), text, legends, shapes, and more. (Page 241.)
11, If you need to automate your work in RockWorks, you can do so with "**RCL**" (RockWare Command Language) scripts. (Page 304.)

Other important notes:

RockWorks2004/2002 BH files can be imported very easily into the RockWorks14 database – see page 54.

Borehole Projects

Creating a New Borehole Project

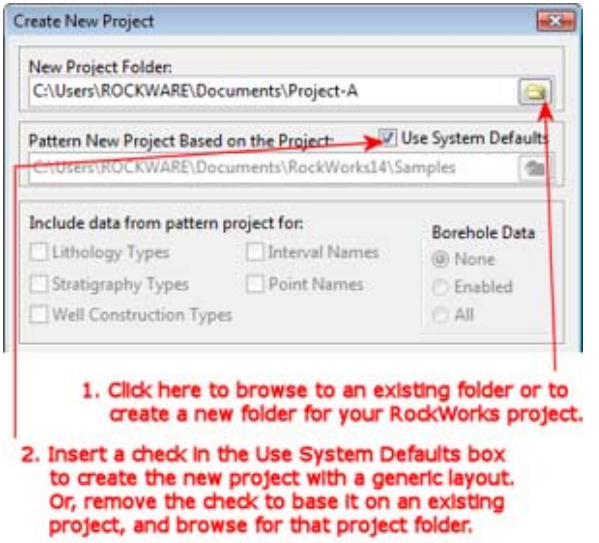
Each project you work on in the Borehole Manager must have its own folder, called a Project Folder, on your computer. The Project Folder is where the borehole database (.MDB) of the same name is created, for storage of borehole data. Graphic files, grid and solid models, and other accessory files for that project should also be saved in the Project Folder.

When you create a new project in RockWorks, you'll be creating two new items on your computer:

- A new folder, with the name of the project
- A new .MDB file inside that folder, with the same name

Follow these steps to create a new project folder:

1. Access the Borehole Manager as necessary, by clicking on the Borehole Manager tab along the left edge of the program window.
2. Choose the File / New Project option. The program will display a Create New Project window.


Create New Project
New Project Folder:
C:\Users\ROCKWARE\Documents\Project-A
Pattern New Project Based on the Project:
Use System Defaults
C:\Users\ROCKWARE\Documents\RockWorks14\Samples
Include data from pattern project for:
Lithology Types
Interval Names
Stratigraphy Types
Point Names
Well Construction Types
Borehole Data
None
Enabled
All
1. Click here to browse to an existing folder or to create a new folder for your RockWorks project.
2. Insert a check in the Use System Defaults box to create the new project with a generic layout. Or, remove the check to base it on an existing project, and browse for that project folder.

3. **New Project Folder**: Click on the open-folder button to the right of this prompt to browse to an existing folder on your computer or to create a new folder.

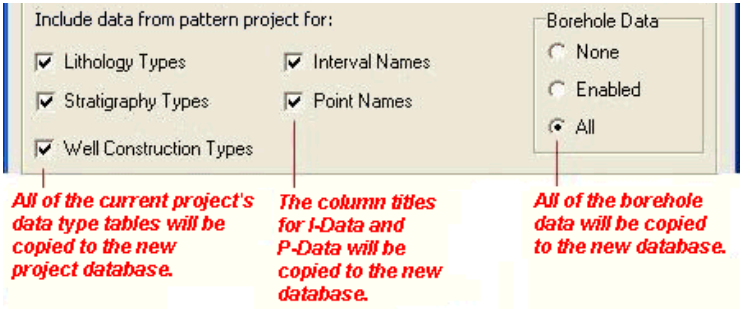
   Or, to create a new folder, select the folder in which the new folder is to be created, and click on the Make New Folder button shown along the bottom of the window. A "new folder" will be placed inside the selected folder, ready for you to type in a name.

4. **Pattern New Project Based on the Project...** For this prompt you have a choice:

   - If you want to create a completely new, blank project using generic (factory) default settings, be sure there is a check in the Use System Defaults checkbox. This is a good choice if you haven't modified the database setup in your projects up to now, with customized tabs or fields.
   - If you want to create your new project based on an existing database, be sure there is NOT a check in the Use System Defaults checkbox. This is a good choice if you have customized another project with new Location fields or new

data tables, and you want this new project to be based on that setup.

5. If you have opted to base this new project on another project, and have browsed for that project name as described above, you can now decide what components to carry over:
   - Select the reference tables to be copied to the new project by inserting checks in the appropriate check-boxes. For example, to copy the Lithology Type and Stratigraphy Types Tables to the new project, you would insert a check in those check-boxes. To copy all of these reference tables to the new project, you would insert checks in all.
   - Select whether the I-Data or P-Data names (column headings) are to be copied to the new project by inserting a check in the ***Interval Names*** and/or ***Point Names*** boxes. For example, if you will be entering the same type of geochemistry data in the new project (e.g. Benzene and Toluene) you could insert a check in the Interval Names option to carry those headings over.
   - Select whether any of the actual borehole data is to be copied to the new project. Choose ***None*** for none of the borehole data, ***Enabled*** for the data for enabled boreholes only, and ***All*** for all borehole data.


Include data from pattern project for:
Lithology Types
Stratigraphy Types
Well Construction Types
Interval Names
Point Names
Borehole Data
None
Enabled
All
All of the current project's data type tables will be copied to the new project database.
The column titles for I-Data and P-Data will be copied to the new database.
All of the borehole data will be copied to the new database.

6. Click OK in the Create New Project window to proceed using the established settings.

The program will:

- Create a new MDB file in the selected folder, assigning the MDB file the same name as the project folder.
- Initialize the database with factory default or existing project-specific data dictionaries.
- Initialize the database with the specified data type tables, if any, interval- and point-data names, if any, and borehole data, if any.
- Open the new project into the Borehole Manager.

Opening an Existing Borehole Project Folder

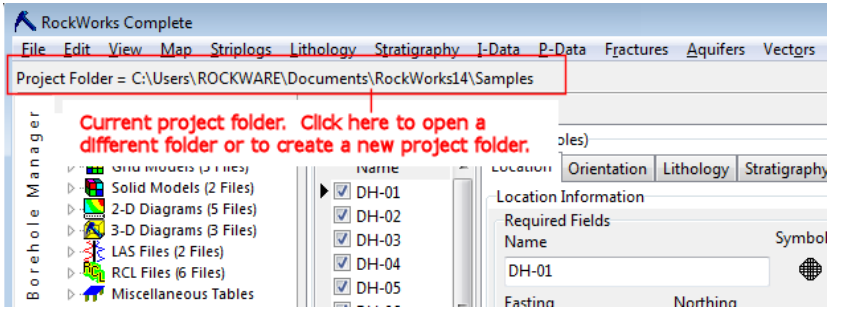
Each project you work on in the Borehole Manager must have its own folder, called a Project Folder, on your computer. The Project Folder is where the borehole database (.MDB) of the same name is created, for storage of borehole data. Graphic files, grid and solid models, and other accessory files for that project should also be saved in the Project Folder.

Follow these steps to open an existing project:

1. Access the Borehole Manager as necessary, by clicking on the Borehole Manager tab along the left edge of the program window.
2. Either:

   Choose the File / Open Project option, or

   Click on the name of the project folder itself, displayed right below the menus.

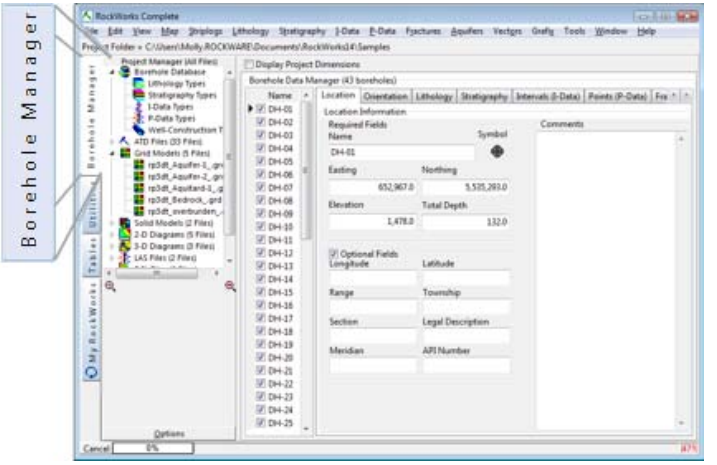


3. Browse for the folder in which the project is stored and click OK.

The existing project will be loaded into the Borehole Manager. It is required that the RockWorks MDB database have the same name as the Project Folder. When you access an existing project folder, the MDB file of the same name will be loaded.

Entering Borehole Data - Overview

The Borehole Manager is one of the two main data windows in RockWorks (see page 18 for an overview). It is used to enter borehole data: downhole stratigraphy, lithology, interval-based or geochemistry measurements, point-based or geophysical measurements, fractures, water level, deviated well surveys, depth to specific log pattens and symbols, well construction, and/or downhole vector data.



The data you enter into the Borehole Manager can be displayed as 2D (flat) images such as cross sections or plan-view well location maps. It can also be displayed in 3-dimensional images such as fence diagrams, floating surfaces, solid models or 3D drillholes in the new "RockPlot3D" viewing program.

The Borehole Manager allows you to choose/create a working Project Folder, into which the data for the different boreholes is stored, as well as program-generated models and images. If you turn on the Project Manager pane (Tools / General Preferences) you can see the RockWorks files that reside in the Project Folder.

The borehole data for each project is stored in a Microsoft Access MDB database. The MDB file has the same name as the project folder, so for a folder named “Samples”, the MDB file is automatically named “Samples.MDB.”

The names of the individual boreholes in the current project are displayed in the long pane to the left of the individual data tabs.

See RockWorks Utilities Datasheet Overview (Chapter 3) for information about that data interface.

Creating a new well entry

Each well in a borehole project is stored as a separate record in the project database. To create a new well in the existing project, follow these steps:

1. Access the Borehole Manager as necessary.
2. If necessary, access the project folder that contains the data to which you wish to add the new well.
3. Select the **File** / **New Log** command.
4. Enter the required fields for the borehole:

Borehole Name: This is a unique identifying field for the borehole. You cannot have multiple boreholes in the same database that share the same name.

Easting, **Northing**: Enter the Easting or X-coordinate and the Northing or Y-coordinate for the borehole in feet or meters. Be sure the units match the depth units (feet or meters) you'll be entering.

See page 39, for information about X,Y units.

If your locations are in longitude/latitude coordinates or Jeffersonian (RTS) descriptions, you'll need to enter 0 initially for this prompt, enter the coordinates you do have in the optional location fields and use the coordinate translation tools to compute the Easting coordinate. Use the See Also links below for more information.

Elevation: Type in the elevation at the top of the well. Be sure the elevation units (feet or meters) are the same as the Easting and Northing units.

TD: Enter the total depth for the well. Be sure the TD units (feet or meters) are the same as the Easting, Northing and Elevation units. If the well is inclined or deviated, this should be the measured depth, not the true vertical depth.

5. Click ***OK***.

The well name will be shown in the Borehole Name listing. The required fields that you entered will be displayed on the well's Location tab. There will be a blank suite of data tabs (Lithology, etc.) into which you can enter data for the borehole.

! Note: You can also use the **File** / **Duplicate Log** option to create the new borehole record based on an existing borehole.

See also: Entering the Borehole Data (page 35)

Help / Contents / Index / Optional Fields for information about adding customized fields to the location table.

Deleting a well

Each well in a borehole project is stored as a separate record in the project database. To remove an existing well record from the current project, follow these steps:

1. Access the Borehole Manager as necessary.
2. If necessary, access the project folder that contains the data you wish to edit.
3. In the pane to the left, click on the name of the Borehole File that you wish to remove from the current project. For example, to remove the borehole named "DH-5", click on that well's name.
4. Select the **File** / **Erase Log** command.

The program will prompt you, "Delete all the information for "*wellname*"? The data is not recoverable?"

5. Click ***Yes*** to continue and delete the entire borehole record from the database.

   Click ***Cancel*** to cancel the ***Erase Log*** operation.

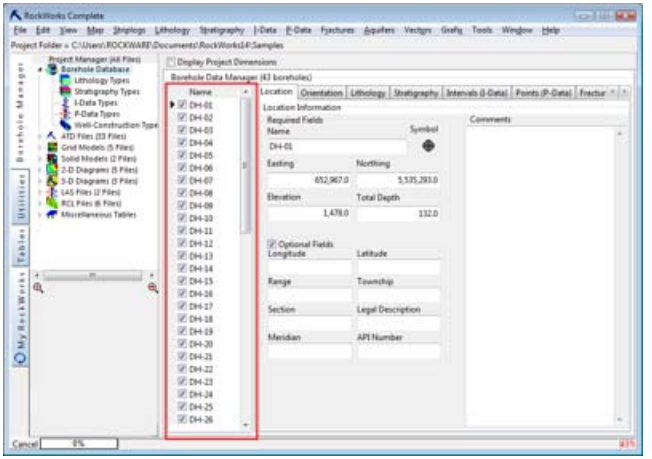
! If you choose ***Yes***, the data in the selected borehole file will be removed from the project.

Note that any existing grid (surface) or solid (plume) models you've already created using the now-deleted borehole will NOT be automatically updated to reflect the data change. You'll need to re-generate models and graphics.

Accessing a well's data

1. Access the Borehole Manager as necessary.
2. Open the existing project as necessary.

The wells in the current project will be displayed in the pane just to the right of the project manager pane.



3. Click on the name of the well you wish to view.

The program will load its data into the data tabs. You can click on the various data tabs to see that boring's data.

Enabling/Disabling Borehole Records

Use the check-boxes to the left of the borehole names to turn the borehole on (checked) or off (un-checked). If the borehole is enabled, it will be included in borehole location maps and log section diagrams, and its data will be processed during surface or solid model interpolation. If the borehole is disabled, it will not be included in these maps, diagrams, or interpolation processes.

You can use **Edit** / **Enable All Boreholes** to turn all borehole records on, and **Edit** / **Disable All Boreholes** to turn all borehole records off.

See also: Querying Data (page 67) for database query tools for enabling/disabling boreholes.

Borehole Manager Database - Overview

Starting in RockWorks2006 and continuing to the current version, the data for the Borehole Manager is stored in a Microsoft Access-compatible database or MDB file. This is in contrast to the file structure for RockWorks2002 and 2004, which utilized ASCII text files for the storage of each, individual borehole file. Despite the new data structure, the look and feel of the Borehole Manager is much the same now as it was in v.2004.

Some of the benefits of using a database structure for data storage include:

- **Relational integrity**: The database keeps track of records in a table that refer to records in other tables, such a stratigraphic unit for a borehole linking to the Stratigraphy Types Table.
- **Queries**: RockWorks contains some built-in query tools, that allow you (for example) to enable all boreholes that contain a particular formation or lie within a specific area. In addition, advanced users could use Access for detailed queries.
- **Data validation**: Numerical values are checked and stored, preventing entry of alphabetic characters. Date fields (like Water Level Dates) are validated to be actual date/time values.

Some important notes:

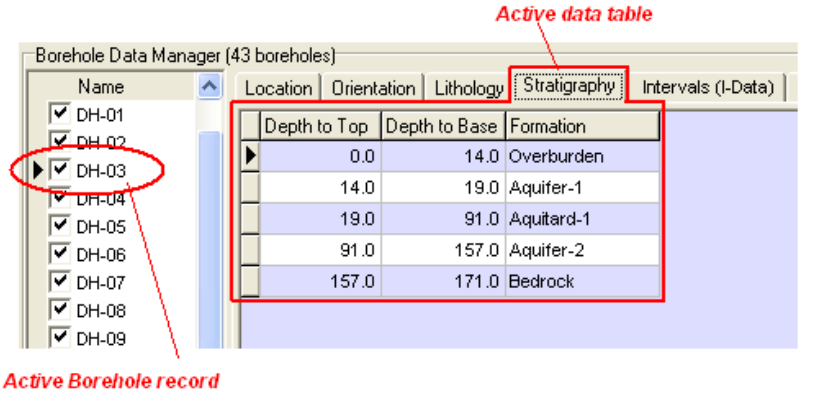
- RockWorks uses a project folder for storage of all borehole data and related files.
- The MDB file that's created for a new project will be assigned the same name as the project folder. For example, if you create a new project folder named "Denver", then the project database will be named "Denver.mdb".
- When you access a folder containing .BH files from RockWorks2002 or RockWorks2004, the program will launch a wizard that will walk you through the steps to import the individual borehole files into the database.
- Lookup tables, such as those that define stratigraphy types and lithology types, are stored in the database.
- The data dictionaries, which define available fields, which tabs are displayed, etc., are stored in a "system" folder inside your project folder. This allows you to maintain custom data dictionaries for different projects.
- You do not need to have Access installed on your computer to use the RockWorks database. The behind-the-scenes database components, called the Microsoft Jet

Database Engine, are installed with the Windows operating system. See the Help messages for more specifics re: Jet version compatibility.

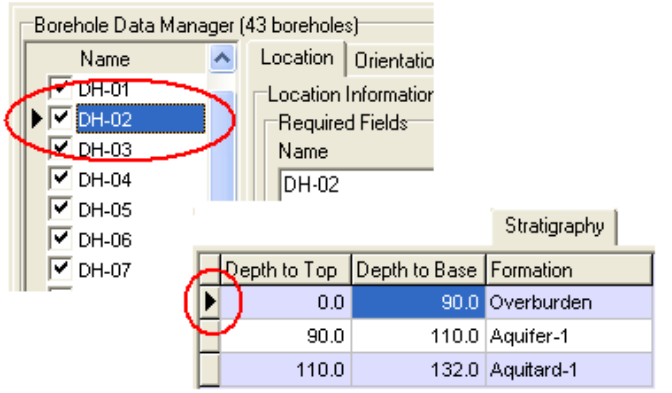
See Help / Contents / Borehole Manager / Entering Your Borehole Data / Borehole Manager Database.

Database Navigation Tips

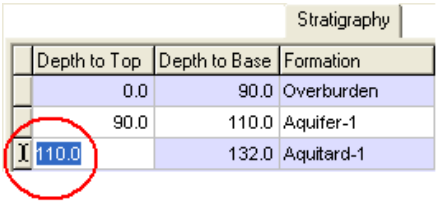
Active Table: The tables for each borehole are displayed in the Borehole Manager window, with stick-up tabs noting the table name.



Active Row: When you click on a record in the database, such as the name of a borehole or a row in the Stratigraphy table, the cursor will be shown as a triangle to show the active record.

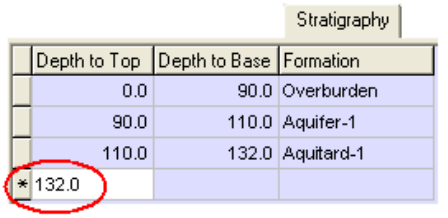


Editing Fields: When editing, the record pointer will change to an "I-beam". This mode can be entered into by pressing the function key F2 or by double-clicking in the cell to be edited.



Inserting Records: Insert mode is indicated by the record pointer changing to an asterisk "*". A new record is inserted by

- Pressing the insert key or
- Moving to the last record and pressing the down-arrow key.
- Right-clicking and choosing Insert.



Canceling: Both insert and edit modes can be cancelled by pressing the escape "Esc" key. This will cancel any edits that are in progress.

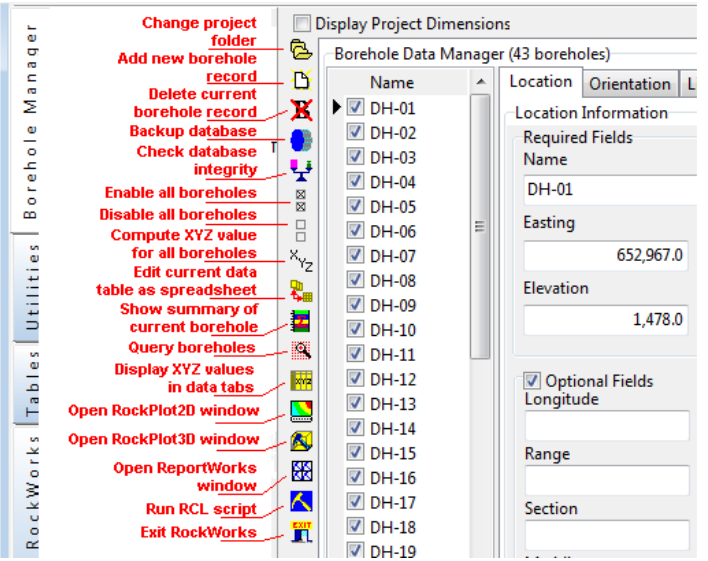
Deleting Records: Deleting a record is done by

- Typing Ctrl-Del (holding down the Ctrl key and pressing the Delete key)
- Right-clicking and choosing Delete.

See also: Editing Borehole Records as a Spreadsheet (page 51).

Quick Summary of the Borehole Manager Buttons

Use the Tools / General Preferences / Main Menu Options to turn on the toolbar buttons described below.



See these Help / Contents / Borehole Manager / Entering Your Borehole Data / Borehole Manager Database topics for additional information.

- Backup database
- Check database integrity
- Enable all boreholes
- Disable all boreholes
- Compute XYZ values for all boreholes
- Display XYZ values in data tabs

Configuring the Data Tables

"Underneath the hood" of RockWorks is a collection of information about the RockWorks database itself. This "meta" data is called a Data Dictionary.

The Data Dictionary gives RockWorks a lot of versatility: You can change the names of your Borehole Manager tabs, their order and background color; even hide those tabs you do not use. You can add optional borehole information, such as the drilling company or date of initial boring or hide these optional fields if you do not use them.

! Changes that you make to the Data Dictionaries are stored in a "system" folder inside your project folder. This allows you to maintain different Dictionaries for different projects.

See these Help / Contents / Borehole Manager / Entering Your Borehole Data / Borehole Manager Database topics for additional information.

- Summary of the RockWorks Database Tables
- Database Engine Specs

Customizing the Tab Display

The default setup for RockWorks will allow display of all of the data tabs discussed in the previous section. You can adjust which tabs are displayed and you can customize the fields within the tabs by following these steps:

1. Access the Borehole Manager.
2. Open the existing borehole project if necessary.
3. Right-click on any of the tabs and choose the Tab Manager option. You can also choose the **View** / **Tab Manager** menu option.
4. Customize the tab as described below:
   - To turn off the display of any data table, simply remove the check-mark from its check-box. Note that the table will still be present in the database, it simply will not be displayed in the Borehole Manager window.
   - To change the order in which the tabs are displayed in the Borehole Manager window, click on a tab name in the Tab Manager listing and then click on the up-arrow or down-arrow as appropriate to adjust the tab sequence. The first name in the list will be displayed along the left edge of the Borehole Manager window, and the last name in the list will be along the right.
   - To change the name displayed on the tab itself or the background color of the row-and-column view of the data, double-click on the tab name in the Tab Manager listing, and adjust these settings in the Edit Tab Sheet window.
   - To change the fields that are stored in the tab, click on the name of the tab in the Tab Manager window, and then select the Edit / Edit Fields option. Use the Add a New Field button to add a field to the data tab.
     ! At the time of this writing, new fields that you create in the database will not be usable by RockWorks, but they can be used to store accessory data for the borehole. For example, if you were to add a “Comments” field to the Stratigraphy data tab, you can add descriptive information about the formation intervals for storage in the database, even though you won’t be able to display this text in a strip log.

See Help / Contents / Borehole Manager / Entering Your Borehole Data / Borehole Manager Database.

Backing Up, Restoring, and Refreshing the Database

Use the **File** / **Backup Database** tool to make a backup copy of the current .MDB file and the project's data dictionaries. We generally recommend that you do this from time to time, particularly before importing data, deleting data, or filtering data, should you

inadvertently make changes you don't wish to keep. You can use the **File** / **Restore Database** option to restore a backup copy as current.

Use the **File** / **Refresh Database** option to reopen the current project database without having to exit and re-launch the program.

Checking the Data and Database Integrity

Use the File / Check Database Integrity tool to compare the contents of your current project database against the general program data dictionaries, to see a report of the items that are not in synch and to fix all those that it can. This can be helpful in the event that fields have been added to one of your projects and you re-open another project and the older database no longer matches the modified data dictionaries.

Use the File / Check Data Integrity option to perform a database check (above) AND also read through the borehole data itself to check for mis-ordered stratigraphic units, mis-placed Total Depths, etc.

Entering the Borehole Data

Overview of Data Types

The RockWorks Borehole Manager uses data "tabs" for entering the different types of downhole data. For example, if your well is inclined or deviated, you can enter the downhole survey information in the "Orientation" tab. If you have point-sampled geophysical data, you can enter these into the "Points (P-Data)" tab.

When you add a new well to a project, the program will display a blank suite of data tabs. Simply click on a tab to bring it to the front for entering your data. You may leave those tabs blank for which you have no data. Only the Location tab is required to contain data.

The tabs display a spreadsheet-type view of the information in the MDB database tables.

This section discusses the different data tabs and how you enter the data.

See also: Importing Data on page 53, and Editing the Data as a Spreadsheet on page 51.

See Help / Contents / Borehole Manager / Entering Data for more detailed information.

Location Tab

This is used to enter the well ID, X and Y location coordinates (Eastings and Northings), surface elevation, and total depth (**all required fields**). You may also choose a specific symbol for the well, which can be used to note the well location in maps. There is a "Comments" field where you can enter well-specific notes.

There are optional fields for entering a well's API number, or for entering well locations in Range and Township notations or in longitude and latitude coordinates, for translation into Eastings and Northings.

! Right-click on the Location tab to add custom, optional fields to the table.

Easting and Northing Limits: The well location Easting (X) and Northing (Y) coordinates may be listed in global units (UTM meters or feet) or in local units (meters or feet). Note the following:

* The location coordinates must represent the same units in which the depths (total depth in the Location tab and data depths in the other tabs) are recorded. Thus, if your depths are entered in feet, so must be your Eastings and Northings. If your depths are entered in meters, then enter your Eastings and Northings in meters also. RockWorks does not require specific units, it simply assumes the map units and the depth units are the same.
* RockWorks assumes you know what your units are - feet or meters or inches or centimeters - and as long as they are consistent (as described above) you do not need to declare them anywhere in the program. You can adjust the text that is plotted along map borders to specify the units (map border settings), and you can adjust some of the program's different report settings, to specify your units, in the report options windows.
* If your location coordinates are in decimal longitude and latitude units (such as "-106.89765" or "42.574635"), note:

  ! You should enter your decimal longitude and latitude coordinates in the longitude and latitude prompts in the Location window. Then use the Borehole Manager's **Map** / **Adjust Coordinates** / **Longitude/Latitude -> Easting/Northing** command to change them to UTM meters or feet.
* If your location coordinates are in Range/Township/Section notation:

  ! You should enter the Range, Township, Section, Meridian, and Description information in the appropriate prompts at the bottom of the Location tab. Then use the Borehole Manager's **Map** / **Adjust Coordinates** / **Jeffersonian -> Easting/Northing** command to change them to UTM meters or feet.
* The X-coordinates or Eastings must increase in value to the East, and the Y-coordinates or Northings must increase in value to the North. If you are using lon/lat coordinates for translation to meters or feet, be sure that western longitudes and southern latitudes are entered as negatives.

Posting Locations from the RockWorks Utilities datasheet: If you have well location data listed in rows and columns in the RockWorks Utilities datasheet, you can transfer these data into the Borehole Manager using the **File** / **Transfer** / **Locations -> Borehole Manager** tool. The fields in the datasheet can be mapped to specific fields in the Location tabs.

See Help / Contents / Index / Optional Fields for information about customizing the Location table in the project database. See Adjusting Total Depths (p 53) for a quick means of adjusting TD to accommodate deeper data.

Orientation Tab

This tab is where you enter your downhole survey information, if the well is inclined or deviated (e.g. not vertical).

Orientation Fields

- Depth: Enter the first depth at which a downhole survey measurement was made. The depth values must be positive.

  ! The depth units must be the same as the units declared for the xyz coordinates for the hole. For example, if the x,y location and collar elevation are expressed in local feet, then the depth listings must be in feet as well.

- Bearing: Enter the bearing of the well at this depth. The bearings must be expressed in decimal azimuth degrees (0 to 360, with 0 = north).
- Inclination: Enter the inclination at this depth. The inclination data follows a convention in which zero is a horizontal line, -90 points straight down, and +90 points straight up.

	Depth	Bearing	Inclination
▶	0	270	-90
	15	270	-90
	20	270	-60
	25	270	-30
	30	270	0

You can enter as many survey points as you like, to generate very detailed inclined, deviated, or horizontal well displays. If the well is vertical, this tab can be left blank.

Lithology Tab

Enter into this table observed downhole lithologies.

Lithology Fields

- Depth to Top: Enter the measured depth to the top of the first lithologic interval for the well. The depth values must be positive.
- Depth to Base: Enter the measured depth to the base of the first lithologic interval for the well.
- Keyword: Double-click in this cell and choose the material type from the Lithology Types Table (see page 253). Or, you can single-click in this cell, click the small down arrow, and choose the material type from the drop-down list. If the material type is not listed, you'll need to add it to the current Lithology Types Table.

- Description: This optional field can be used for recording any additional notes about the interval. This text can be plotted in 2D strip logs.

	Depth to Top	Depth to Base	Keyword	Comment
▶	0	10	Topsoil	
	10	30	Silt	
	30	40	Coal	
	40	50	Clay	
	50	70	Silt	
	70	80	Shale	
	80	90	Clay	
	90	100	Silt	
	100	111	Sand	
	111	120	Sand	Wet
	120	128	Gravel	Wet
	128	132	Mudstone	

Lithology data can be displayed in 2D and 3D log and log diagrams using the options in the Striplogs menu. Lithology data can also be interpolated into a solid model for display as a 3D voxel diagram, 3D fence panels, 2D cross sections and profile panels, and lithology surface and plan-view maps (Lithology menu tools)..

(See also Lithology v Stratigraphy on page 58 for help on definitions.)

Stratigraphy Tab

Into this table you can enter interpreted downhole stratigraphic or formation data.

Stratigraphy Fields

- Depth to Top: Enter the measured depth to the top of the first stratigraphic horizon for the well. The depth values must be positive.
- Depth to Base: Enter the measured depth to the base of the first stratigraphic horizon for the well. If you don't know the formation base – perhaps the borehole ends mid-formation – you can leave this blank. See Missing Formations (page 61) for more information.
- Formation: Double-click in this cell and choose the unit name from the Stratigraphy Types Table – a library of stratigraphic names and patterns that is stored in the project database. Or, you can single-click in this cell, click the small down arrow, and choose the formation name from the drop-down list.

  If the formation name is not listed, you'll need to add it to the current Stratigraphy Types Table. See the Stratigraphy Types Table (page 255) for more information.

! Stratigraphic layers must be listed in the same order from borehole to borehole. Units can be missing, but they cannot change order.

	Depth to Top	Depth to Base	Formation
▶	0	85	Vadose Zone
	85	100	Aquifer-1
	100	132	Aquitard-1
	132	132	Aquifer-2
	132	142	Bedrock

Stratigraphy data can be illustrated in in 2D and 3D log and log diagrams using the options in the Striplogs menu. Stratigraphy data can also be interpolated into surfaces for display as 2D and 3D structure and isopach maps, 3D stratigraphic models, 2D cross section and profile panels, 3D fence panels, and stratigraphic surface and plan-view maps (Stratigraphy menu tools)..

See also these Stratigraphy data topics: Picking Stratigraphic Units from Log data (page 134), Lithology versus Stratigraphy (page 58), Missing Formations (page 61).

Intervals (I-Data)

This table is used to enter measured, numeric values which were sampled at depth ***intervals*** (as opposed to single depth points) down the boreholes. This might apply to downhole geochemistry values (assays, concentrations) or geotechnical values (blow counts). Leave this table blank if you have no interval data.

I-Data Fields

- Depth to Top: Enter the measured depth to the top of the first sampled interval for the well. The depth values must be positive.
- Depth to Base: Enter the measured depth to the base of the first sampled interval for the well.
- Column 1: Here you enter the measured value for that downhole interval. If you have no data for an interval, you can leave the cell blank. Blank cells will simply be skipped during processing.
- Column 2 - Column x: Continue in this manner, typing in the measured value for each component, for that interval. Repeat for as many columns as you have measurements for, for that depth interval.

Right-click anywhere in the data table and choose Show Column Names Dialog to define the column names for the measurement types (e.g. Benzene, Gold, percent-gravel, etc.) The columns link to an Interval Types Table where names, data ranges, etc. are defined.

	Depth to Top	Depth to Base	Benzene	Porosity	Gold	Sand
▶	0.0	5.0	0.05	0.30	0.01	30
	5.0	10.0	0.13	0.30	0.01	30
	10.0	15.0	0.04	0.05	0.01	5
	15.0	20.0	0.23	0.05	0.01	5
	20.0	25.0	0.17	0.10	0.01	10
	25.0	30.0	0.10	0.10	0.01	10
	30.0	35.0	0.03	0.40	0.01	40
	35.0	40.0	0.05	0.40	0.01	40
	40.0	45.0	0.07	0.10	0.01	10
	45.0	50.0	0.17	0.10	0.01	10
	50.0	55.0	0.04	0.05	0.01	5
	55.0	60.0	0.18	0.05	0.01	5
	60.0	65.0	0.27	0.10	0.01	10

These data can be displayed as bar graphs along 2D and 3D strip logs, and can be interpolated into a solid model for display as isosurface or voxel models, vertical profiles, cross sections, fence diagrams, and plan maps.

Note that each I-Data tab represents a merging of the records stored in the MDB table. See Editing the Data as a Spreadsheet (page 51) for how to view the data with multi-select and copy/paste tools.

Points (P-Data)

This table is used to enter measured values which were sampled at single depth ***points*** (as opposed to depth intervals) down the boreholes. This might apply to downhole geophysical measurements (gamma ray), drilling rate, etc. Leave this table blank if you have no point data

P-Data Fields

- Depth to Top: Enter the measured depth for the first measurement for the well. The depth values must be positive.
- Column 1: Enter here the measured value for that downhole point. If you have no data, you can leave the cell blank. Blank cells will simply be skipped during processing.
- Column 2 - Column x: Continue in this manner, typing in the measured value for each component, for that depth. Repeat for as many columns as you have measurements for, for that depth.

Right-click anywhere in the data table, and choose Show Column Names Dialog, to define the column names for the measurement types (e.g. Gamma, Resistivity, etc.) for the project. The columns link to a Point Types Table where names, data ranges, etc. are defined.

	Depth	Gamma	Resistivity
▶	0.0	0.03	0.09
	1.0	0.13	0.11
	2.0	0.17	0.1
	3.0	0.2	0.09
	4.0	0.21	0.09
	5.0	0.17	0.11
	6.0	0.12	0.13
	7.0	0.1	0.15
	8.0	0.12	0.17
	9.0	0.14	0.16
	10.0	0.12	0.13
	11.0	0.1	0.09
	12.0	0.12	0.06

These data can be displayed as curves along 2D and 3D strip logs, and can be interpolated into a solid model for display as isosurface or voxel models, vertical profiles, cross sections, fence diagrams, and plan maps.

Note that each P-Data tab represents a merging of the records stored in the MDB table. See Editing the Data as a Spreadsheet (page 51) for how to view the data with multi-select and copy/paste tools.

See Importing Data (page 53) for topics regarding importing LAS files, etc. See P-Data Manipulation Tools (page 152) for topics regarding manipulating the point values (resampling, convering to logarithmic/uranium grade, etc.)

Fractures

Use this table to enter sub-surface fractures that you wish to display on logs and log cross sections, or model as a solid for display as a profile, cross section, fence, plan map, fracture surface map, or solid model.

Fracture Data fields:

- Depth: Type in the measured depth for the first fracture you wish to record. The depth values must be positive.
- Direction: Enter the dip bearing in azimuth degrees (from 0 to 360) of the fracture.
- Dip Angle: Enter the angle in degrees from horizontal (0 = horizontal, 90 = straight down).
- Radius: Enter the fracture radius, in your data units (feet, meters). This will determine the size of the fracture disk as displayed on 3D striplogs, and will affect any fracture modeling you perform. This setting will be ignored if, during strip log setup, you set the Fractures / Dimensions to Fixed and enter a value there.
- Aperture: Enter the fracture thickness. When displayed in RockPlot3D this will affect the thickness of the fracture disk as it's displayed with the logs. The fracture aperture is entered as actual thickness units, in the same units as your other downhole data.

For example, if your other log data is entered in feet, the fracture aperture must also be entered as decimal feet. This setting will be ignored if, during strip log setup, you set the Fractures / Dimensions to Fixed and enter a value there.

- Color: Double-click in this cell and choose a color for the fracture "disk" that will be displayed in the logs and log sections.

	Depth	Direction	Dip Angle	Radius	Aperture	Color
▶	49.0	225.0	45.0	75.0	1.0	
	85.0	315.0	30.0	75.0	1.0	

Water Levels

This table is sed to enter one or more dates, depths, and optional text for observed water level(s) in the boreholes.

Date: Here you enter the date on which the measurement was taken, by typing it in or double-clicking in the cell and choosing a date. On logs, the date field can be displayed as a text label. For profile, plan, fence, and solid diagrams, RockWorks will use the Date field to match like measurements between wells. For this reason, you can enter the date in any numeric format; the program should be able to match "1/1/01" with "01/01/2001". You cannot use an alphabetic format (e.g. "January 1 2001"). The date and time formats will automatically adjust to U.S. or European formats based on the Windows Regional Settings.

Depth to Top: Type in the measured depth to the top of the water level. The depth values must be positive.

Depth to Base: Type in the measured depth to the bottom of the water interval. If you wish to display the water level as a surface of little or no thickness, set the Base depth to slightly greater than or equal to the Top depth. If you are not drilling to the base of the aquifer and wish to note the upper surface only, you can set the base depth to a value just slightly deeper than the top.

	Date of Sample	Depth to Top	Depth to Base
▶	1/1/2001	65.0	81.0
	2/15/2001	122.0	154.0

Water level intervals can be displayed in logs and log sections as color-filled bars, and they can be modeled as surfaces for display as profile and cross section panels, fence diagrams, plan maps, or 3D surfaces.

Symbols

Use this table to enter one or more depths for each borehole and the symbol to be plotted at each depth in individual logs and in log sections.

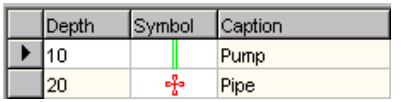
Symbol Tab fields

- Depth: Type in the measured depth for the first symbol you wish to record. The depth values must be positive.

  ! The symbol will typically be positioned with its center plotted at the declared depth. This is not the case if the symbol's "origin," as it was created in the symbol editor, is not in its center. See the Help messages for more details.

- Symbol: Double-click in this cell to pick the desired symbol from the displayed index to the library of symbols. You can pick a color for the symbol by clicking in the Color box. Click OK to return to the data table.

- Caption: Type in any text you want to be plotted with the symbol on the log. This is not required.



	Depth	Symbol	Caption
▶	10		Pump
	20		Pipe

See page 260 for information about the RockWorks Symbol library.

Patterns

Use this table to select specific graphic patterns to be plotted along a depth interval in individual logs or in log sections.

Data fields:

- Depth to Top: Enter the measured depth to the top of the interval to be filled with the pattern block. The depth values must be positive.

- Depth to Base: Enter the measured depth to the bottom of the pattern interval.

- Pattern: Double-click here to pick the desired pattern from the displayed index. You can pick foreground and background colors for the pattern by clicking in the Color boxes. You can also adjust the pattern density by adjusting the Density setting; the Preview box will show you the current design, colors, and density for your reference. Click OK to return to the data table. Initially, only the pattern number will be displayed in the cell, but when you <Tab> or click into another cell, the display will refresh with the graphic design and color.

- Caption: (optional) Enter here any text you want to be plotted with the pattern on the log.

	Depth to Top	Depth to Base	Pattern	Caption
▶	10	20		Screen

See the discussion of Lithology data and Stratigraphy data, earlier in this section, for information about entering downhole rock types and formation names, also associated with graphic patterns in logs and sections. See the discussion of Well Construction data, below, for information about entering downhole construction materials that allow multiple pattern columns.

Bitmaps

Use this table to enter one or more depth intervals for each borehole and the name of the image to be plotted between these depths, in individual logs and in log cross sections. These can represent raster logs, downhole images, core samples, and more. Raster images are limited to display in vertical logs only (2D) and vertical and inclined logs only in 3D.

RockWorks contains an interactive tool for depth-calibrating the raster images.

1. Double-click in the Filename field to browse for the name of the first image to be listed for this well and click the Open button to open it. This file must reside in the current project folder.

You will see the image displayed in a preview window. Now you can depth register the image. Note that you can use the scroll bars to view portions of the image outside the current window, and the Image Size prompt at the bottom to zoom in and out of the image display

2. Click on any point near the top of the log. This is typically the very top of the background grid, but it can actually be any point within the log where the depth is known.
3. Once the point has been selected, a red horizontal line will be drawn at the designated depth and you will be prompted to enter the depth at that location. Type in the depth and click OK.
4. Move the cursor to any point near the base of the log. This is typically the very base of the background grid, but it can actually be any point within the log where the depth is known.
5. Once the lower point has been selected, a green horizontal line will be drawn at the designated depth and the user will be prompted to enter the depth at that location. Enter the depth and click OK.

The Raster Log Calibrator screen will disappear and the appropriate information be computed and displayed within the Bitmaps tab. This eliminates the need to load the raster image into another program to determine the header and footer offsets.

	Depth to Top	Depth to Base	Header Base	Footer Top	Filename
▶	0.0	132.0	569	2439	bh_01_pic_01.png

See the Help messages for more details about the calibration screens, and about the Bitmaps fields.

Vectors

The Vectors table is used to enter directional data such as groundwater flow directions, tiltmeter data, sonar data (current flow), etc. This table can also be used to enter laser distance measurements in sub-surface, for cavern modeling.

Data fields:

- Depth: Enter the measured depth to the vector origin. The depth values must be positive.
- Direction: Enter the direction of the vector from the well, in azimuth degrees (from 0 to 360).
- Inclination: Enter the vector's angle in degrees from horizontal (0 = horizontal, -90 = straight down, and 90 = straight up).
- Color: Double-click in this cell and choose a color for the vector arrow that will be displayed in the logs and log sections.
- Magnitude: Enter the current flow rate or any other parameter that is used to define the "strength" of the vector. This can be used to scale the vector arrow in the logs. **!** If these represent laser distance measurements in a cavern, the value will represent actual distance.

Depth	Azimuth	Inclination	Color	Value
10.0	18.0	4.0		40.0
20.0	23.0	1.0		48.0
30.0	22.0	4.0		42.0
50.0	11.0	18.0		37.0
70.0	28.0	15.0		31.0
80.0	11.0	3.0		43.0
100.0	27.0	10.0		18.0
110.0	18.0	10.0		30.0
120.0	22.0	2.0		40.0
130.0	19.0	17.0		49.0

Vectores are displayed as arrows in 3D logs, and as tadpoles in 2D logs and sections. They can be interpolated into “cavern” models using the Vectors / Model option.

Well Construction

This table is used to enter depth intervals and well material "keywords" for display as a Well Construction diagram on striplogs. In addition, the user declares the inner and outer diameter for the materials for correct representation of width. The construction "keywords" are associated with graphic patterns just like lithologic keywords, and are easily selected from the data tab. In addition you can specify an "offset" from well center, enabling you to display two separate borings in a single Well Construction diagram.

Data fields:

- Depth to Top: Enter the measured depth to the top of the interval to be filled with the pattern block. The depth values must be positive.
- Depth to Base: Enter the measured depth to the bottom of the pattern interval.
- Outer Diameter: The value entered in this column determines the outer width of the pattern blocks in the Well Construction Column. This is set up in the Log Designer to represent a particular well diameter, in real world coordinates such as inches or

centimeters. The Outer Diameter setting established here determines how much of the width of the entire Well Column will be filled with that pattern block.

Example: Let's say you've set up the Well Construction Column to have a diameter of 15 inches. If you then declared a pattern interval in the Well Construction data table to have an Outer Diameter of "15," the pattern block would be plotted all the way to the edge of the column.

- Inner Diameter: The value entered in this column determines how far to the center of the Well Construction Column that the interval will be filled with the pattern block.
- Material: Double-click in this cell and choose the unit name from the Well Construction Types Table. Or, you can single-click in this cell, click the small down arrow, and choose the name from the drop-down list.

  If the material name is not listed, you'll need to add it to the current Well Construction Types Table. See the Well Construction Types Table section (page 256) for more information.
- Offset: This setting is used to declare the offset from the center of the well that this material block is to be plotted, enabling multiple borings within a single construction diagram. Negative values offset the block to the left of the center, positive values to the right.
- Caption: (optional) Enter here any text you want to be plotted with the diagram on the log.

Depth to Top	Depth to Base	Outer Diameter	Inner Diameter	Material	Offset	Caption
0.0	3.0	3.0	0.0	Cap	0.0	Cap
0.0	3.0	6.0	3.0	Cap	0.0	Cap
3.0	30.0	6.0	3.0	Cement	0.0	Cement
30.0	45.0	6.0	3.0	Bentonite	0.0	Bentonite
45.0	75.0	6.0	3.0	Sand Pack	0.0	Sand Pack
52.0	75.0	3.0	0.0	Screen	0.0	Screen
75.0	78.0	3.0	0.0	Cap	0.0	Cap
75.0	78.0	6.0	3.0	Cap	0.0	Cap
78.0	90.0	3.0	0.0	Bentonite	0.0	Bentonite

See Help / Contents / Borehole Manager / Entering Your Borehole Data / Entering the Borehole Data.

Viewing a well data summary

If you wish to see a summary of the data contained in a particular well in your borehole project, follow these steps:

1. Access the Borehole Manager.
2. Open the existing borehole project if necessary.
3. Click on the name of the well in the list to the left, for which you wish to see a data

summary. The program will load that well's data.

4. Select the **View** / **Borehole Summary** command.

The program will scan the current well's data listing and will display a summary of its data in a text window. Included will be a summary of the given data (coordinates, total intervals, etc.) as well as computed coordinates from the survey data.

Viewing I-Data and P-Data Statistics

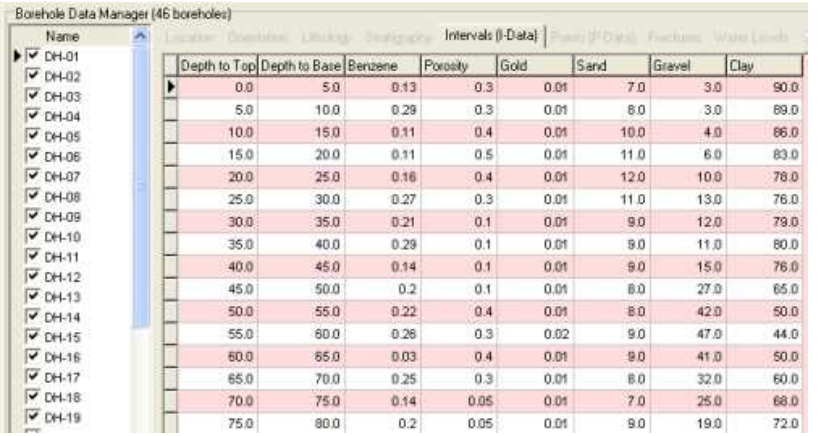
Use the **I-Data** / **Stats** and **P-Data** / **Stats** tools to compute basic statistics for a single track in the I-Data and P-Data tables. These menus also contain a Histogram option whereby a single track of values can be represented by a frequency histogram. See page 193 for more information.

Entering Project Information

Use the **View** / **Project Information** option to enter miscellaneous notes about the project, which will be stored in the project database. This information can be retrieved any time by selecting the **Project Information** menu command.

Editing Borehole Records as a Spreadsheet

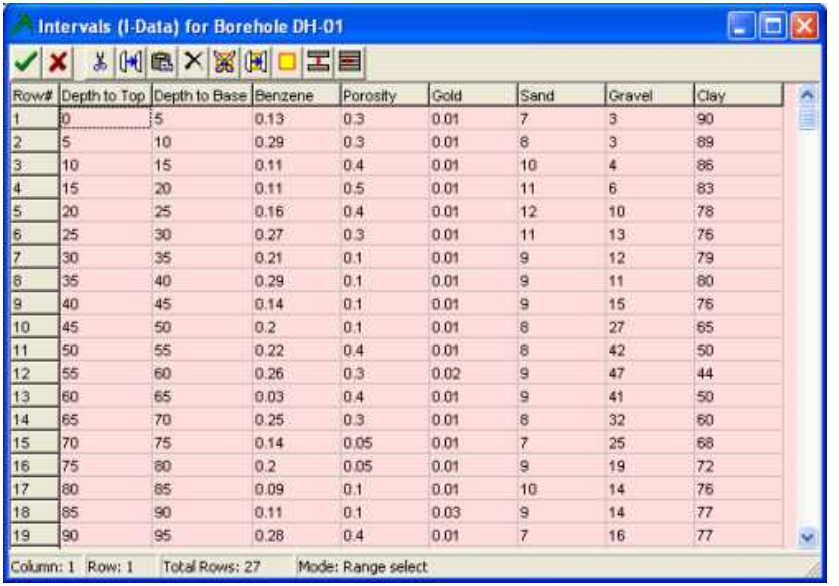
Although the Borehole data tables look like spreadsheets:



Depth to Top	Depth to Base	Benzene	Porosity	Gold	Sand	Gravel	Clay
0.0	5.0	0.13	0.3	0.01	7.0	3.0	90.0
5.0	10.0	0.29	0.3	0.01	8.0	3.0	89.0
10.0	15.0	0.11	0.4	0.01	10.0	4.0	86.0
15.0	20.0	0.11	0.5	0.01	11.0	6.0	83.0
20.0	25.0	0.16	0.4	0.01	12.0	10.0	78.0
25.0	30.0	0.27	0.3	0.01	11.0	13.0	76.0
30.0	35.0	0.21	0.1	0.01	9.0	12.0	79.0
35.0	40.0	0.29	0.1	0.01	9.0	11.0	80.0
40.0	45.0	0.14	0.1	0.01	9.0	15.0	76.0
45.0	50.0	0.2	0.1	0.01	8.0	27.0	65.0
50.0	55.0	0.22	0.4	0.01	8.0	42.0	50.0
55.0	60.0	0.26	0.3	0.02	9.0	47.0	44.0
60.0	65.0	0.03	0.4	0.01	9.0	41.0	50.0
65.0	70.0	0.25	0.3	0.01	8.0	32.0	60.0
70.0	75.0	0.14	0.05	0.01	7.0	25.0	68.0
75.0	80.0	0.2	0.05	0.01	9.0	19.0	72.0

they are not. Instead, they are a fairly complicated merging of separate database tables. While you can type into these tables, just like you can with a regular spreadsheet, you cannot select a block of cells or copy/paste a block of cells like you can with a normal spreadsheet.

There IS, however, a tool in the Borehole Manager's **Edit** menu that will load the active borehole's current (in front) data into a spreadsheet-style editor and allow standard copy/paste editing tools.



Follow these steps:

1. Access the Borehole Manager as necessary.
2. Open the project to be edited.
3. Select the borehole to be edited by clicking on its name in the Name listing.
4. Click on the data table to be edited.
5. Select the **Edit** / **Edit Data as Spreadsheet** option.
6. The program will load the current borehole's data listing into a spreadsheet-style window.
7. Edit the data.
8. When you're done:

   Click the button to accept the changes and post the data to the database. You'll be returned to the Borehole Manager.

   Click the button to cancel the editing changes and return to the Borehole Manager.

See Help / Contents / Borehole Manager / Entering Your Borehole Data / Entering the Borehole Data.

Adjusting Total Depths

Use **Edit** / **Adjust Total Depths** tool to scan all of the data for each borehole in the current project database, and adjust the Total Depth (Location tab) for the borehole should it be shallower than deeper data values. Because RockWorks uses the TD field to determine the base of data for each borehole, this tool assures that deeper data won't be ignored.

If the scan process generated no TD adjustments, you'll be advised as such. If the scan process did generate TD adjustments, it will display a summary window.

See Help / Contents / Borehole Manager / Entering Your Borehole Data / Borehole Manager Database.

Calculating XYZ Values

As you enter your downhole data into the Borehole Manager, RockWorks computes and stores the true XYZ coordinates for each downhole measurement. It computes them based on the borehole's Easting and Northing, surface elevation, measurement depths, and any downhole survey information you enter for non-vertical holes. All of this happens behind the scenes, though you can request that the XYZ coordinates be displayed in the data windows using the View / Show XYZ Values, below. If you import your data from Excel or ASCII files, the XYZ computations happen during the import process.

There may be some instances in which you'll need to tell the program to recalculate the XYZ coordinates. Let's say you've entered the borehole's Location data and downhole Lithology intervals. For each Lithology depth interval you enter, RockWorks would compute and store the true XYZ coordinates based on a vertical hole. If you then edit the surface elevation or add downhole survey information into the Orientation tab, the program will recognize that this new data will have rendered the existing XYZ computations to be in error. The program typically posts the message "XYZ Not Calculated" to the borehole's Location tab.

You must then use one of the following menu commands:

Edit / **Calculate XYZ Values** - forces the program to recompute the downhole XYZ coordinates for all boreholes in the project. WARNING: If you have a lot of boreholes or downhole data measurements, this can take a while.

Edit / **Calculate XYZ Values for Current Borehole** - forces the program to recompute the downhole XYZ coordinates for the current borehole only.

See Help / Contents / Borehole Manager / Entering Your Borehole Data / Borehole Manager Database.

Displaying XYZ Columns in the Data Tables

As described above, as RockWorks processes your downhole data to generate models and diagrams, it reads each data field as entered and computes the true XYZ location of each

measurement. This is necessary for two reasons: (1) Boreholes may not be vertical and (2) the data are entered in depths rather than true elevations.

Typically the computation of the XYZ coordinates is done in the background, behind the scenes, and stored in the data tables out of normal view. However, if you would like to view the XYZ computations, you simply need to activate the display of those columns. You can do this using the View / Show XYZ Values option. Selecting this menu option will toggle the display on and off.

See Help / Contents / Borehole Manager / Entering Your Borehole Data / Borehole Manager Database.

Importing Data

Importing ASCII Data

The **File / Import** / **ASCII** option is used for bringing data into Borehole Manager from a single or multiple external ASCII files.

Unlike earlier versions of RockWorks, the ASCII import tool can append to existing borehole records. This means that any data being imported that references existing borehole names (records) will simply be written to the existing record's fields. For example, if your existing database contains Location records for DH1 and DH2, you can append Lithology data for those same boreholes. You cannot, however, append to individual data tables. For example, if you already have lithology data stored in the borehole database, importing lithology data from the ASCII file will replace all of the existing lithology data.

See Help / Contents / Borehole Manager / Entering your Borehole Data / Importing Data for details.

Importing gINT Data

Use the **File** / **Import** / **gINT** option to import data from the gINT software program into the Borehole Manager database. This program requires the following:

- You have gINT, version 7.1.039 or newer, installed onto your computer.
- You have created a "correspondence file" in gINT, as described in that program's documentation.

See Help / Contents / Borehole Manager / Entering your Borehole Data / Importing Data for details.

Importing GDS Well Data

The **File** / **Import** / **GDS** option Geological Data Service's GDSII or flat-file format files into the Borehole Manager. A separate borehole record will be created for each well number.

See Help / Contents / Borehole Manager / Entering your Borehole Data / Importing Data for details about the import steps, and how the well fields are recorded to the database.

Importing IHS Well Data

The **File** / **Import** / **IHS PI/DWIGHT** option imports IHS Energy Group's 297 Well Data format files into the Borehole Manager. This format is an updated version of the legacy PI 197 Well Export format. A separate borehole record will be created for each well number.

See Help / Contents / Borehole Manager / Entering your Borehole Data / Importing Data for details about the import steps, and how the well fields are recorded to the database.

Importing Kansas Geological Survey Well Data

The **File** / **Import** / **Kansas Geological Survey** option imports tops data provided by KGS. This import uses the same framework as the IGH, GDS, and Tobin imports.

See Help / Contents / Borehole Manager / Entering your Borehole Data / Importing Data for details about the import steps, and how the well fields are recorded to the database.

Importing LAS Data

Use the **File** / **Import** / **LAS** or File / Import / Multiple LAS options to import data from a single or multiple LAS (Log ASCII Standard) files, version 1.2 - 2 for import into the Location and P-Data tables of an existing borehole or a new well record. You can select the curves in the LAS file to be imported, and you can request that the header information be imported into Location table fields.

See Help / Contents / Borehole Manager / Entering your Borehole Data / Importing Data for a detailed step-by-step listing.

Importing LogPlot Data

Use the **File** / **Import** / **LogPlot DAT** option to import data from one or more LogPlot DAT files into the Borehole Manager. The data field matching is done using a LogPlot DAT file or ENM file as a template, and a series of screens is displayed to specify which LogPlot data types are to be placed in which RockWorks database tables.

See Help / Contents / Borehole Manager / Entering your Borehole Data / Importing Data for a detailed listing of the import steps.

Importing Newmont Assay MDB Data

Use the **File** / **Import** / **Newmont Assay MDB** option to import data from a Newmont Assay database into the Borehole Manager. The Collar, Survey, and Assays tables are imported.

See Help / Contents / Borehole Manager / Entering your Borehole Data / Importing Data for more information.

Importing Pentrometer Data

The **File** / **Import** / **Penetrometer** option reads a data file output from a Spectrum Technologies Field Scout SC-900 Soil Compaction Meter and import the measurements into the Borehole Manager's Point (P-data) tabs.

See Help / Contents / Borehole Manager / Entering your Borehole Data / Importing Data for details

Importing RockWorks99 Data

If your RockWorks99 ATD and TEM files contain downhole (borehole) data, such as stratigraphic layers, and/or linked LIT, HIS, CUR, or ZON files, you'll need to import them into the RockWorks Borehole Manager database.

! If your RockWorks99 ATD/TEM files *do not* contain borehole information, you can open them into the other RockWorks data window, marked with the RockWorks Utilities data tab. See Chapter 3 for information.

The Borehole Manager's RW99 data importer is found in the **File** / **Import** menu. It will create a new project database for all of the boreholes in your RW99 datasheet, and the different types of downhole data will be listed in the Borehole Manager data tabs.

See Help / Contents / Borehole Manager / Entering your Borehole Data / Importing Data for details

Importing RockWorks2002/2004 Data

In RockWorks version 2006 and newer, the Borehole Manager stores borehole records in a database file (*.MDB) in the project folder, with the same name as the project folder. By contrast, earlier versions of the Borehole Manager stored borehole records in individual ASCII ".BH" files.

If you have upgraded from an earlier version of RockWorks you can import your ASCII .BH files into the database via two methods:

1. If you want to create the database in the existing RockWorks2002/2004 project folder:
    - Launch the current version of RockWorks.

- Open the RockWorks2002/2004 project folder (click on the Project Folder prompt at the top of the window or choose **File** / **Open Project**).
- If the program finds .BH files but no .MDB file, it will automatically launch the import wizard.
- Follow the import steps, described below.
- The MDB file that's created will be assigned the same name as the existing project folder.

2. If you want to create the database in a new project folder:
   - Launch the new version of RockWorks.
   - Open/create the new project folder.
   - Select the **File** / **Import** / **RockWorks2002/2004** option.
   - Follow the import steps, described below.
   - The MDB file that's created will be assigned the same name as the new project folder.
   - If you wish to use any of the existing models (GRD, MOD) or graphic images (RKW, XML, RWR) you'll need to copy them from your old folder to the new.

! This tool imports only the BH files, Lithology Table, Stratigraphy Table, and project dimensions from your older project. It will NOT import grid models, solid models, or graphic files.

See Help / Contents / Borehole Manager / Entering your Borehole Data / Importing Data

Importing Tobin WCS Well Data

The **File** / **Import** / **Tobin WCS** option is used to import data from a Tobin Well Coordinate Service (WCS) file into the RockWorks Borehole Manager. WCS files contain well location and other miscellaneous well information which is imported into the borehole Location tabs. Assigning well names can be based on several data fields, and well symbol is based on the listed well status (D&A, GAS, etc.)

See Help / Contents / Borehole Manager / Entering your Borehole Data / Importing Data

Importing Excel Data

RockWorks also includes an import tool for getting data into Borehole Manager from external XLS (Microsoft Excel) files. This tool is accessible in the **File** / **Import** / **XLS (Excel)** option.

This program will import data from multiple worksheets in a single Excel file into the current project's borehole database.

The format of the Excel worksheets must be the same as that produced by the **File** / **Export** / **Excel** program.

! Unlike the import tool in RockWorks2004 and earlier, the Excel import can now append to existing borehole records. This means that any data being imported that references existing borehole names (records) will simply be written to the existing record's fields. For example, if your existing database contains Location records for DH1 and DH2, you can append Lithology data for those same boreholes. You cannot, however, append to individual data tables. For example, if you already have lithology data stored in the borehole database for DH1 and DH2, importing lithology data from the Excel file for these boreholes will replace all of the existing lithology data for those holes.

See Help / Contents / Borehole Manager / Entering your Borehole Data / Importing Data for additional step-by-step details about using the importer and the structure of the Excel import files.

Importing Fugro CPT Data

The Borehole Manager's **Lithology** menu and **P-Data** menu both contain an **Import** / **Fugro CPT Data** option which imports data from a Fugro Cone Penetrometer file into a Lithology or P-Data tab for the current drillhole. For the Lithology import, the program will concatenate similar intervals such that the lithology doesn't consist of hundreds of small intervals.

See Help / Contents / Borehole Manager / P-Data Tools or Lithology Tools / Importing Data for additional details.

Importing Colog Data

Use the Borehole Manager's **P-Data** / **Colog** option to import data from a Colog borehole geophysics file into the P-Data tab for the current drillhole.

See Help / Contents / Borehole Manager / P-Data Tools.

Other Data Topics

Lithology versus Stratigraphy

RockWorks recognizes two distinct types of borehole rock/soil material:

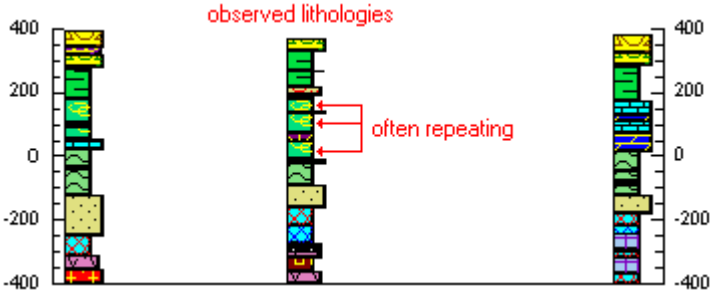
- **Observed Lithology**

  What is "Lithology"?

  In RockWorks, "lithology" data represents your downhole rock or material types that aren't necessarily layered in a specific order. The Lithology entries can repeat (sand, clay, sand, clay). "Observed" is the key word. Observed lithology intervals for each borehole are entered into the Lithology tab, listing depth to top, depth to base, and

rock or material type. This is what many people initially enter.

This means that if you do not initially know the regional stratigraphy, and cannot define discrete layering, you can still plot observed lithology in logs and log-based cross-sections.



How Lithologies are Defined

RockWorks stores in each project database a Lithology Types Table, where you define the names of the rock or material types, the colors and patterns to be used to represent them in logs and diagrams, and some additional settings. (Page 253)

How Lithologies are Modeled

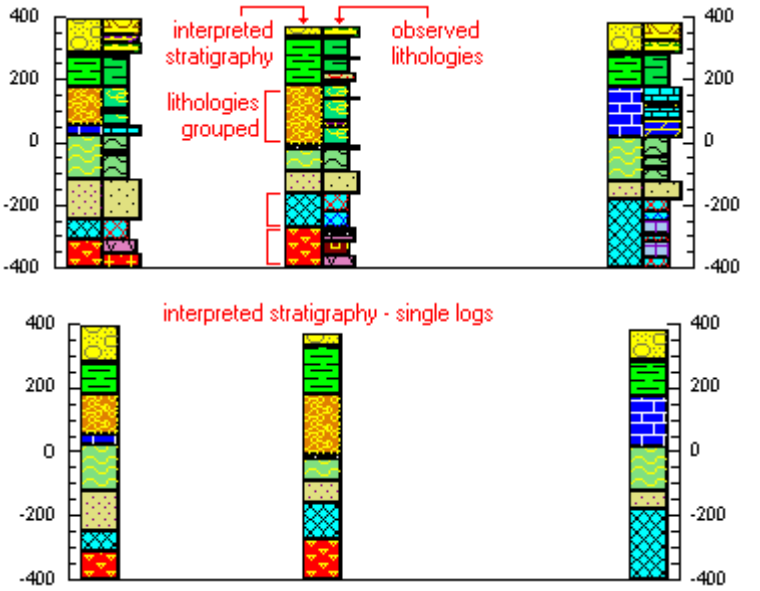
RockWorks allows you to enter repeating lithology intervals within individual boreholes, so they cannot be modeled using surfaces. (You can't create a single surface for the top of a Sand layer, for example, if there are three "Sand" entries for a well.) Because of this, lithology data is modeled using solid modeling techniques, whereby the rock types basically "bleed" out from the boreholes into the surrounding space. This allows RockWorks to create panel sections / fences and block models representing interpolated material types, using the tools in the Borehole Manager's Lithology menu.

If you want to try to group your lithologies into interpreted stratigraphic units, you can do so by hand, or using the Pick Contacts tool in the Stratigraphy menu that allows you to view a lithology (or geophysical) cross section and point-and-click to record stratigraphy depths.

- **Interpreted Stratigraphy**

  What is "Stratigraphy"?

  These are interpreted formations, often groups of lithologies, which are distinctly layered in nature, are consistent between wells in their order from the surface downward, and never repeat within a borehole. Interpreted stratigraphy is entered into the Stratigraphy tab, with depth to formation top, depth to base, and formation name.

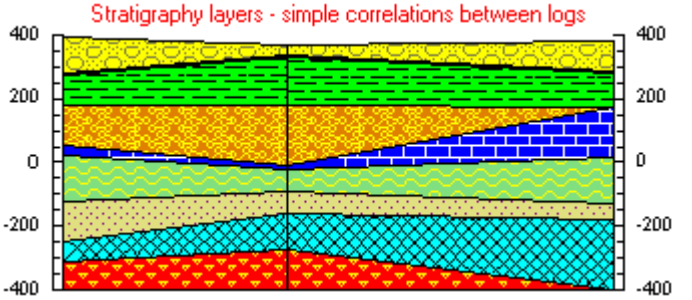


How Stratigraphy Units are Defined

RockWorks stores in each project database a Stratigraphy Types Table , where you define the names of the ordered rock units or layers, the colors and patterns to be used to represent them in logs and diagrams, and some additional settings. (Page 255)

How Stratigraphy is Modeled

Because stratigraphic units are distinctly layered, you can request simple log-to-log correlations (no modeling) in hole to hole or "straight" log sections.



RockWorks can interpolate surface models of each stratigraphic layer for 2D and 3D display; for slicing as profiles, sections, and fences; and for stacking as solid model diagrams. We show below some images created by tools in the Striplogs menu (observed data only) and the Stratigraphy menu (interpolated data).

Lithology	Stratigraphy
Represents observed rock type	Represents interpreted layers or formations
Is often the first step in entering borehole rock types	Is often the second step in entering borehole rock types.
Can contain repeated sequences (sand, clay, sand, clay)	Cannot contain repeated sequences
Rock types can vary in order between wells	Stratigraphy layers must be consistent in order, from the top down, between wells
No lateral variability	Often has lateral variability
Data is entered in the Lithology tab	Data is entered into the Stratigraphy tab
No simple correlation is possible in hole to hole cross sections	Simple correlations are possible in hole to hole cross sections.
Is interpolated as a solid model, for display as slices, fences, or block diagrams	Is interpolated as surface models for display as maps, 3D surfaces, slices, fences, or block diagrams.

Missing Formations

There are several ways to note missing stratigraphic formation data in the Borehole Manager "Stratigraphy" tab. The method you use will affect, at its most basic, how 2D strip logs and log sections are displayed. It will also affect how stratigraphic surface maps, thickness maps, profiles, fence diagrams, and block models are created.

Zero-Thickness Formations

One method of noting a missing formation is to assign the formation top an elevation that results in zero thickness.

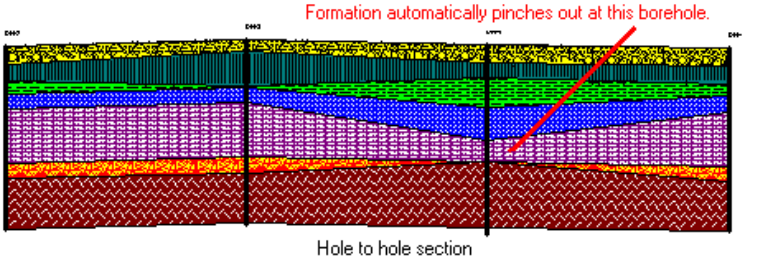
Stratigraphy

Row#	Depth to Top	Depth to Base	Formation
1	0	120	Qal
2	120	215	Tflow
3	215	260	Pierre
4	260	266	Dakota
5	266	500	Morrison
6	500	500	Fountain
7	500	763	Precambrian

The Fountain formation is set to zero thickness.

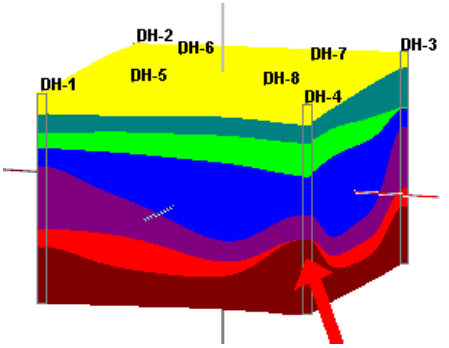
This formation would not appear in individual strip logs.

It would be displayed in hole to hole stratigraphy sections (**Stratigraphy** / **Section** / **Straight**) as pinched out at the well, with pattern fill.



Hole to hole section

The formation's depths for that borehole would be included in computations that generate surfaces and thickness calculations. Note how in this stratigraphic model, the red surface is pulled up to lie on top of the lower surface.



! The **Stratigraphy** menu's **Fill in Missing Stratigraphy** option will insert zero-thickness formations into each borehole record. This can be a very handy tool but be sure (1) that you have correctly defined the stratigraphy order in your Stratigraphy Types table and (2) that you back up your database (when prompted) before completion of this process, just in case you're not happy with the results.

Omitted Formations

Another way to note "no data" is omit the formation name altogether.

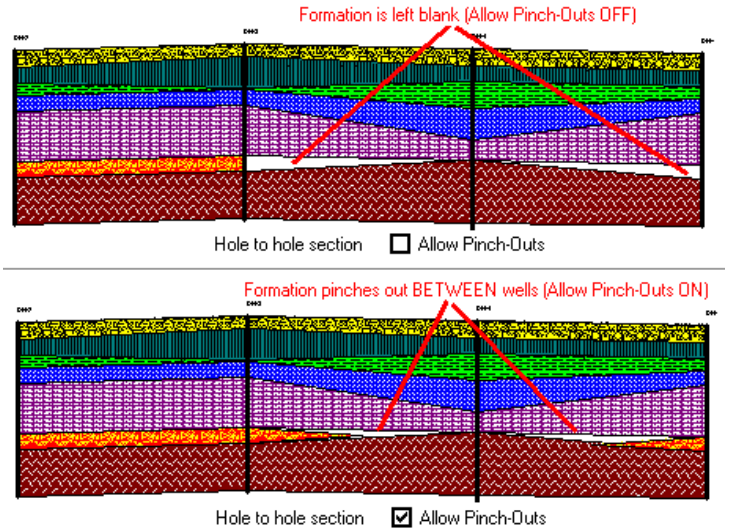
Stratigraphy

Depth to Top	Depth to Base	Formation
0	120	Qal
120	215	Tflow
215	260	Pierre
260	266	Dakota
266	500	Morrison
500	763	Precambrian

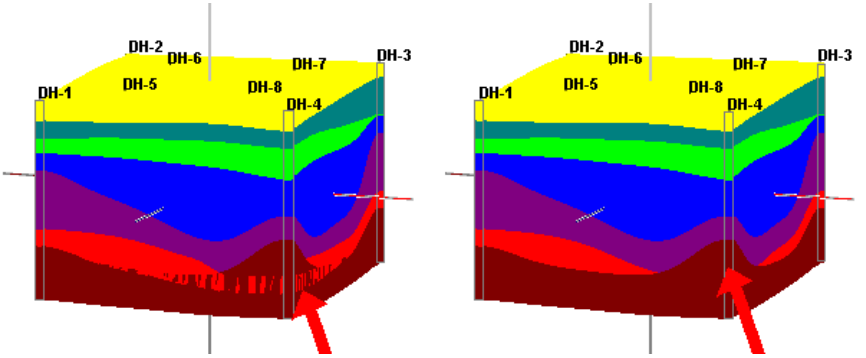
The Fountain formation is not entered at all.

This tells the program that that formation is missing, and it should not be represented in individual strip logs.

It would be displayed in hole to hole sections as pinched out at the well with no fill, or pinched out between wells. There is an "Allow Pinchouts" option in the hole to hole Section window that offers the choice.


Formation is left blank (Allow Pinch-Outs OFF)
Hole to hole section
Allow Pinch-Outs
Formation pinches out BETWEEN wells (Allow Pinch-Outs ON)
Hole to hole section
Allow Pinch-Outs

The omitted formation would *not* be included for that borehole in computations that generate surfaces and thickness calculations. Note how the red surface in the example on the left is not pulled up to lie on top of the lower surface since there is no data for the borehole. Its "interference" with the lower formation is noted with the splotchy lines. On the right, this interference is avoided by activating the "onlap" option in the stratigraphic model settings. Onlap tells the program to build the model from the bottom up and give lower units priority over upper ones.



Missing Formation Bases

Another common scenario occurs when a borehole ends in the middle of a unit, challenging the geologist to decide whether to list the base of the boring as the base of the formation (not entirely correct) or to leave it blank. RockWorks permits you to leave a formation base blank, as shown below:

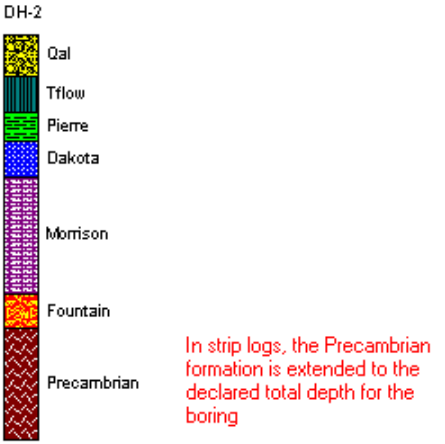
Stratigraphy

Row#	Depth to Top	Depth to Base	Formation
1	0	76	Qal
2	76	146	Tflow
3	146	200	Pierre
4	200	266	Dakota
5	266	489	Morrison
6	489	554	Fountain
7	554		Precambrian

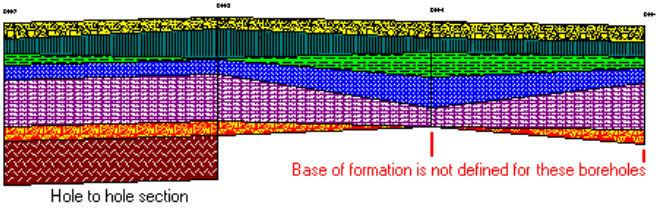
When the borehole ends mid-unit, you can leave the Depth to Base blank.

This will result in the following consequences:

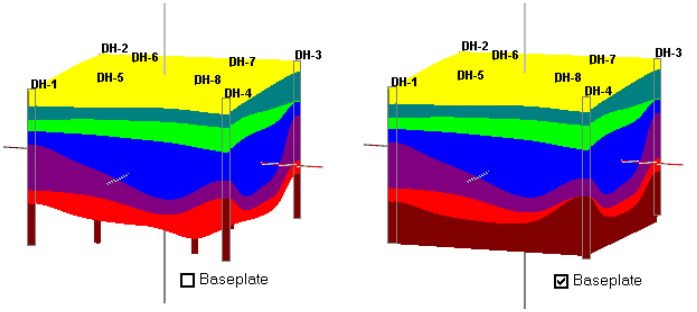
The formation will be extended to the base of the hole in strip logs:



The formation will not be included in hole to hole section panels for those borings in which its base is absent (as in "omitted formations," above).



The formation may or may not be included in stratigraphic models/profiles/fences – it depends on how many borings include the base (for most gridding methods, a minimum of 3 points are required to create a surface). If you there are inadequate control points to create a base surface (or a base surface that you like), you can request the generation of a "baseplate" in stratigraphic profiles, fence diagrams, and models. This simply sets an elevation for the base of the model.



Exporting Borehole Data

The Borehole Manager's **File** / **Export** tools are used to export the contents of one or all boreholes to the following formats:

ASCII (TXT) files (single or multiple files)

Excel (XLS) files – each MDB data table is exported to an Excel worksheet within a single XLS file. Single, enabled, and all boreholes can be exported.

LogPlot (DAT) files – the data for each borehole will be recorded to a LogPlot DAT file format. Single, enables, and all boreholes can be exported.

RockWorks2004 (BH) files – the data for each borehole will be recorded to a RockWorks2004 BH file format.

See Help / Contents / Borehole Manager / Entering Your Borehole Data / Exporting Borehole Data.

See also: Exporting Stratigraphy Data (page 137), Exporting Lithology Data (page 146), Exporting I-Data (page 149).

Transferring the Borehole Data to the RockWorks Utilities

The Borehole Manager's **File** / **Transfer** / **Locations -> Utilities Datagrid** and **Stratigraphy -> Utilities Datagrid** tools are used to transfer data from the Borehole Manager to the RockWorks Utilities for viewing and editing (and possible transfer back to the Borehole Manager). Options include transfer of all borehole locations (for coordinate translation, for use of mapping tools, etc.), all stratigraphic contacts, and the contents of the current borehole datasheet (such as I-data).

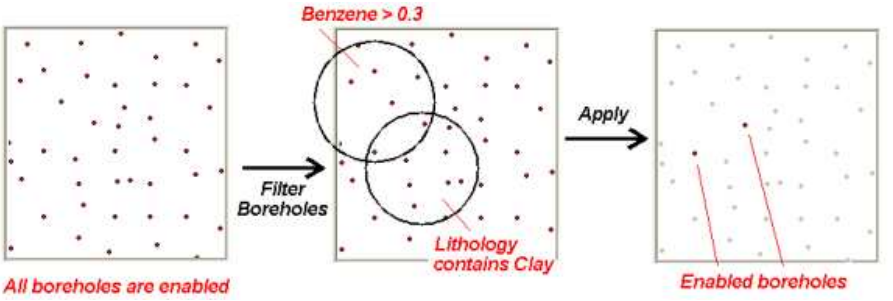
See Help / Contents / Borehole Manager / Entering Your Borehole Data / Transferring Data to the RockWorks Utilities.

Querying the Data

Simple Query

Use the **View** / **Filter Boreholes** tool to query all boreholes in the current project using one or more filters - such as a rectangular map area, specific stratigraphic formations, or specific Location table fields - and disable those boreholes that don't meet all of the criteria. This is a basic "AND" type of filter: each of the boreholes for which every criterion is true will be enabled and the remaining boreholes will be disabled.

Here is a cartoon that shows how the entire database is filtered based on two parameters, and only those wells where the criteria overlap result as enabled.



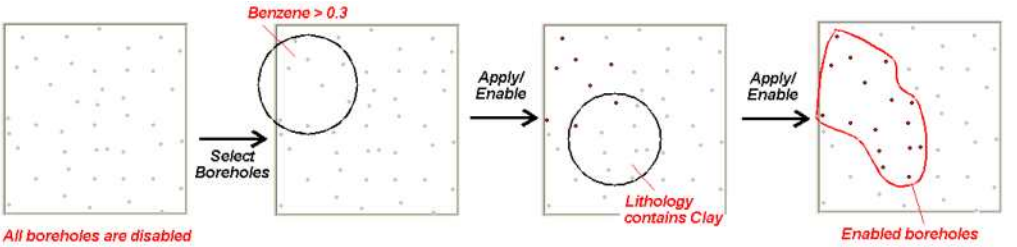
There is a preview window to the right where project boreholes are displayed in red, if currently enabled. Disabled boreholes can be invisible or shown in gray. Clicking the Apply button will leave the dialog box open but update the database using the selected filters and update the preview window.

Filters include map locations, vertical extents, lithology type, stratigraphy type, i-data values, p-data values, water level dates, and optional location fields.

Complex Query

Use the **View** / **Select Boreholes** tool to query a subset of boreholes in the current project using one or more filters, and either enable or disable those boreholes. This is similar to the Filter option, except that the Select tool allows successive filters to be applied, and the enabling/disabling will apply only to the boreholes meeting the filter parameters, and no others. So, while the Filter Boreholes tool works as an AND filter, the Select Boreholes tool can function as an AND or OR filter.

Here is a cartoon that shows how successive Select filters can incrementally enable boreholes using specific filters:



There is a preview window to the right where project boreholes are displayed in red, if currently enabled. Disabled boreholes can be invisible or shown in gray. Clicking the Apply button will leave the dialog box open but update the database using the selected filters and update the preview window.

Filters include map locations, vertical extents, lithology type, stratigraphy type, i-data values, p-data values, water level dates, and optional location fields.

Help / Contents / Borehole Manager / Entering Your Borehole Data / Querying the Database.

Locating the Closest Borehole

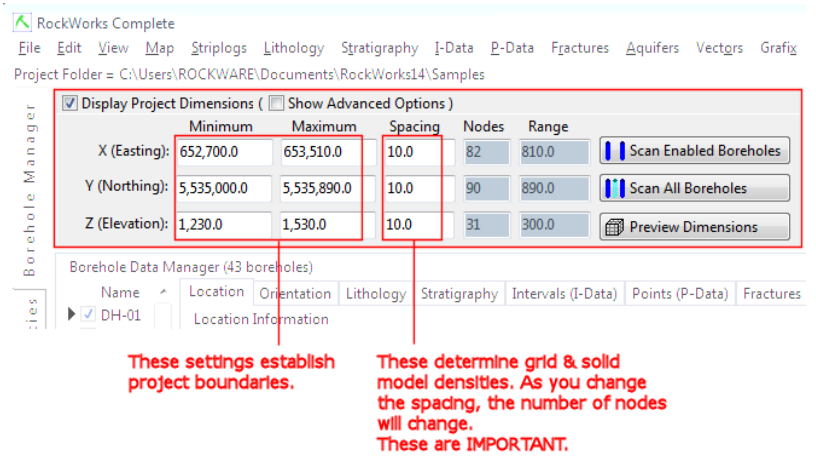
The **View** / **Locate Closest Borehole** option can be used to determine the borehole record whose X and Y coordinates are closest to an XY coordinate pair typed in by the user. This tool is also available interactively in the Rockplot2D window.

Help / Contents / Borehole Manager / Entering Your Borehole Data / Querying the Database.

Viewing and Setting Your Project Dimensions

The Project Dimensions define for the program the boundary coordinates of your project, and the spacing of the nodes for grid and solid models, which can apply universally to the current project.

The current Project Dimensions can be viewed at the top of the Borehole Manager display by inserting a check in the Display Project Dimensions box:


RockWorks Complete
File Edit View Map Striplogs Lithology Stratigraphy I-Data P-Data Fractures Aquifers Vectors Grafix
Project Folder = C:\Users\ROCKWARE\Documents\RockWorks14\Samples
Borehole Manager
Display Project Dimensions (Show Advanced Options)
Minimum Maximum Spacing Nodes Range
X (Easting): 652,700.0 653,510.0 10.0 82 810.0
Y (Northing): 5,535,000.0 5,535,890.0 10.0 90 890.0
Z (Elevation): 1,230.0 1,530.0 10.0 31 300.0
Scan Enabled Boreholes
Scan All Boreholes
Preview Dimensions
Borehole Data Manager (43 boreholes)
Name Location Orientation Lithology Stratigraphy Intervals (I-Data) Points (P-Data) Fractures
DH-01
Location Information
These settings establish project boundaries.
These determine grid & solid model densities. As you change the spacing, the number of nodes will change.
These are IMPORTANT.

This window is also displayed when you click the Adjust Project Dimensions link from many of the program's menus, shown below.

These settings are stored in the current project database. Though these dimensions can be overridden during model and diagram creation, we generally recommend that you utilize these dimensions for your grid models, solid models, and diagram annotations for ease and consistency. For example, all the project grid models must have the same dimensions and node densities if you wish to perform any mathematical or filtering operations with them. The same holds true for solid models.

For new projects the dimensions will default to a range of 0 to 100 along all axes.

1. The first step in setting project dimensions is by scanning the borehole data you have entered. You have two options:

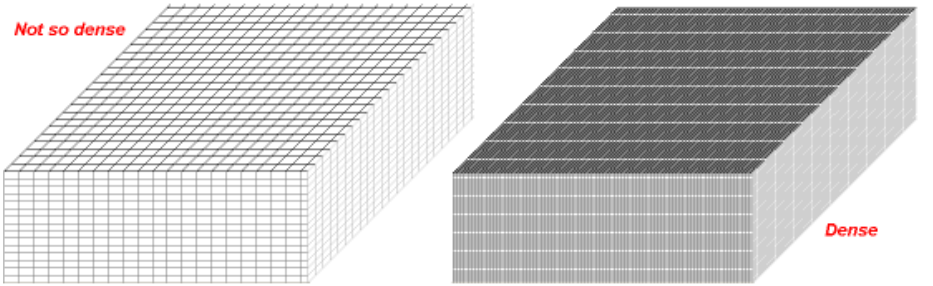
   Scan Enabled Boreholes: Click on this option if the dimensions are to be established by scanning only the boreholes that are enabled (have check-marks).

   Scan All Boreholes: Click on this button if you have a borehole project and the dimensions are to be established by scanning all of the boreholes.

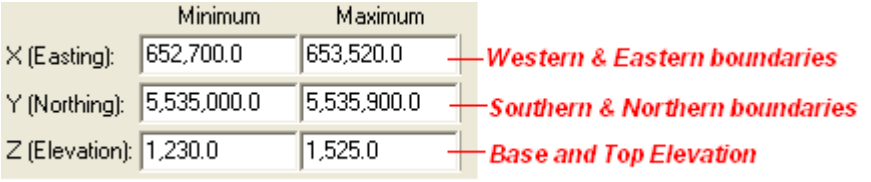
! Of course, you can hand-enter the desired boundary coordinates or modify scanned coordinates at any time.

2. Review scanned settings:

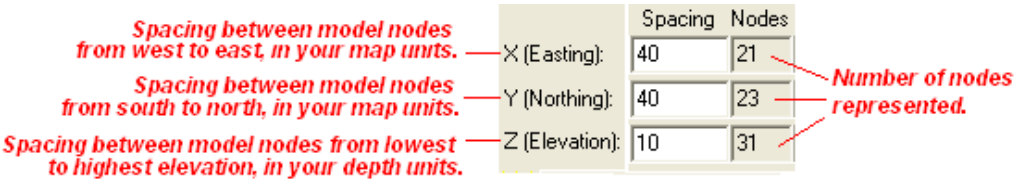
   Click the Preview Dimensions button to see a quick view of how dense your models will be:



Dimensions: These boundary coordinates can be hand-entered or can be determined by the program by clicking on of the buttons listed above. The X and Y boundaries represent your map coordinates. The Z boundaries represent elevation extents.



Spacing: These settings pertain to grid models and solid models. They represent the spacing between nodes in the X (west to east), Y (south to north), and Z (elevation) dimensions. LOOK AT THESE NUMBERS. Node density affects the quality of the model and the time necessary to generate it.



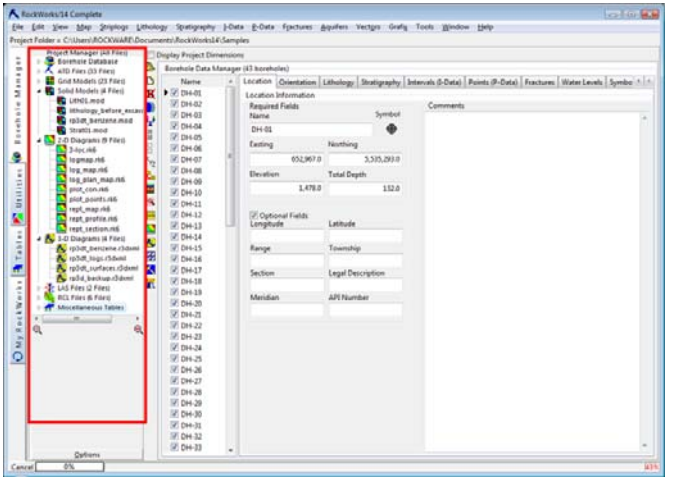
Nodes: These prompts display the number of nodes that will be generated along each axis. These are computed automatically, based on the dimensions divided by the spacing. You cannot edit the node settings; to adjust the density, edit the spacing.

Show Advanced Options: Insert a check here to display project dimension statistics and other settings. These are discussed fully in the Help messages.

Help / Contents / Setting Project Dimensions and Preferences

Using the Project Manager

The Project Manager is a pane that can be displayed along the left edge of the program window which displays various RockWorks program files in the current project folder.

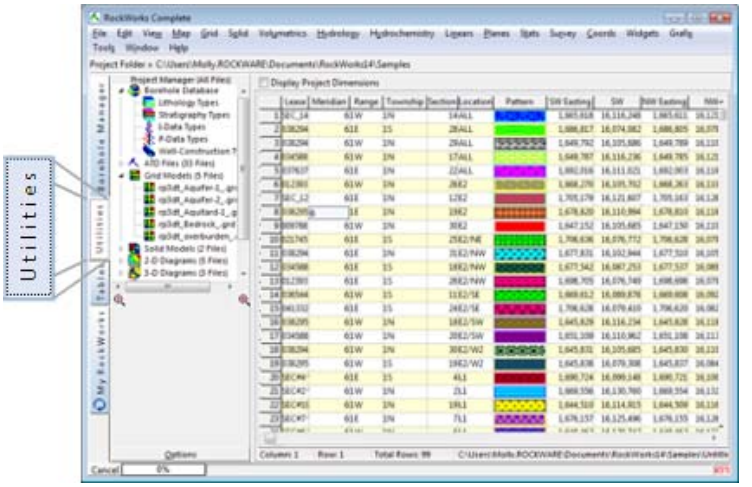


- Turn the Project Manager pane on/off using the **Tools** / **General Preferences** / **Display Project Manager** checkbox.
- Expand any file-type grouping by clicking the small "+" button by its heading; contract any grouping by clicking on the small "-" button.
- Hover over 2D Diagrams and 3D Diagrams files to view previews of the images. (The previews can be disabled in **Tools** / **General Preferences** / **Display Project Manager** / **Display Diagram Previews**.)
- Open a file (database Types tables, ATD files, RK6 and R3DXML diagrams, and miscellaneous tables) by double-clicking on its name in the Project Manager pane. (Or, right-click on the file name and choose the view/load/edit option.)
- Create a 2D contour map or 3D surface of a grid model by double-clicking on the GRD file name and establishing the map/diagram settings. (Or, right-click on the file name and choose Display Grid.)
- Create a 3D voxel or isosurface diagram of a solid model by double-clicking on the MOD file name and establishing the diagram settings. (Or, right-click and choose Display Solid.)
- Start an LAS file import by double-clicking on the LAS file name in the Project Manager pane.
- Start an RCL script by double-clicking on the RCL file name in the Project Manager pane.

Chapter 3 - The RockWorks Utilities Datasheet

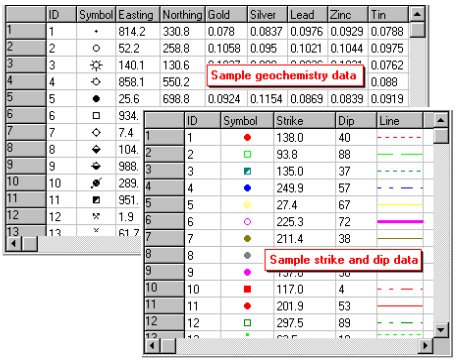
Entering Your Data

The RockWorks Utilities datasheet is one of the two main data windows in RockWorks. It is used for entering general types of data.



(The other main data window is the Borehole Manager, specifically for entering borehole data – downhole stratigraphy, lithology, geochemistry, geophysical measurements, water level, etc. See Chapter 2 for information about that data window.)

The data you enter into the RockWorks Utilities datasheet can include simple XYZ data for generating point and contour maps, strike and dip data for stereonet plots, hydrochemical ion lists for Piper diagrams, and many more. This is a simplified datasheet in which data can be entered in a row and column format, with cut-copy-paste options.



The data you enter into the RockWorks Utilities datasheet can be used to create many different types of maps and diagrams within RockWorks.

The RockWorks Utilities datasheet is saved in an ASCII Tab-Delimited format with the file name extension ".atd". The column headings and column styles (text or symbols or lines or colors) are stored in a header block at the top of the file.

See ATD File Format in the Help / Reference section for details.

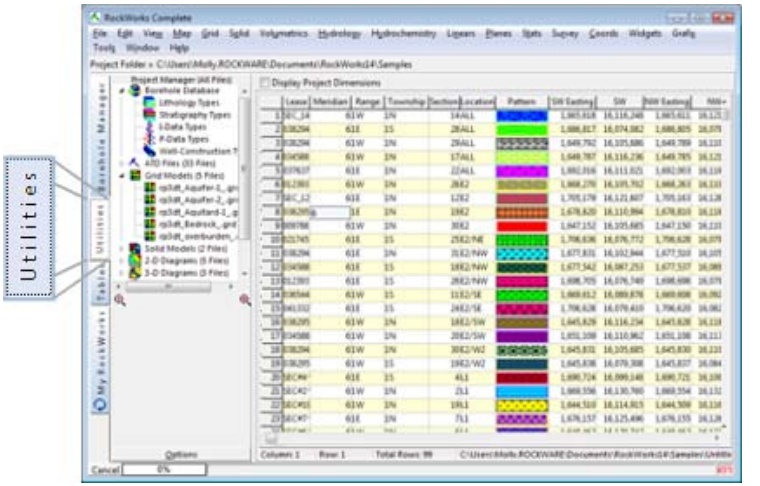
Using the Datasheet

The "RockWorks Utilities" datasheet is a basic row-and-column data window that is one of two data windows available in RockWorks. This section discusses how to create new datasheet files, and how to open, save, and print these data files.

RockWorks99 users note that there are distinct instructions for opening RockWorks99 ATD files. See the topic below.

How to access the datasheet

To access the RockWorks Utilities datasheet, click on the Utilities button along the left side of the main program menu:



How to create a new datasheet

To display a new, blank datasheet, follow these steps:

1. Access the RockWorks Utilities Datasheet.
2. Select the **File / New Datasheet** command.

   If there have been changes in the existing datasheet that have not yet been saved, the

program will prompt you whether you wish to save them.

Click ***Yes*** to save changes in the existing datasheet, or click ***No*** to discard the changes in the existing datasheet.

3. Choose from the next window the type of column headers for the new file.

   This window will list a variety of column layouts, from generic styles with numbered column titles, to hydrochemistry ion layout. You may expand topics (click on the "+" symbol) to view sub-topics. When you click on a layout sample, the column titles and their types will be displayed to the right.

   ! If you don't know which to choose or prefer to design your own column titles, choose ***Numbered Column Titles***. Later, use the **View** / **Columns** tool to modify the column names and types.

   ! RockWorks99 users: Column headings are no longer stored in the TEM files. In fact, RockWorks2004 no longer uses TEM files at all. See ATD file format in the Help messages Reference section for details.

4. Click ***OK***.

The program will display a new, untitled datasheet, with the column headings you selected. The file will be displayed as untitled in the upper title bar ("untitled.atd").

How to open an existing datasheet (RW2002-current)

To open an existing datasheet that you have saved in RockWorks version 2002 to current, you have a couple of options:

Using the Project Manager:

1. If you have the Project Manager pane displayed, just double-click on the name of the ATD file you wish to open. (See page 101 for more information.)

Using the Menus:

1. Access the RockWorks Utilities datasheet.
2. Select the **File / Open Datasheet** command.
3. In the pop-up menu, click either the ***Select*** option to browse for the ATD file you wish to open, or choose one of the files in the “history” list that’s displayed there.

   The default data file type is ATD.

4. When the desired file name is shown in the window, click ***OK*** to continue.

The program will load the file information into the datasheet’s cells. The column headers are loaded from the header block listed in the file. The name of the current data file will be displayed in the title bar at the top of the program window.

You can refer to the files in the "My Documents\RockWorks14\Samples" folder for formatting examples.

See also: Opening RockWorks99 Datasheets (below) for information about opening earlier-version files. **View** / **Columns** for information about changing column titles and types.

How to open a RockWorks99 (and earlier) datasheet

Since RockWorks no longer uses a "Template" (TEM) file for datasheet layout, the process of opening a datasheet created in an earlier version of the program is slightly different.

See also: Importing RockWorks99 data into the Borehole Manager (page 56) if your data represents downhole data.

Follow these steps to open RockWorks99 (and earlier) ATD files into the RockWorks Utilities datasheet:

1. Access the RockWorks Utilities datasheet.
2. Click on the **File** menu and choose the **Open Datasheet** / **Select** option.
3. Browse for the existing RockWorks99 (or RockWorks98 or Stratos98) ATD file you wish to open, accessing other drives and directories as necessary.
4. When the desired file name is shown in the window, click ***OK*** to continue.

In the next window, the program will explain that the selected ATD file doesn't contain a header block because it's from an older version of RockWorks or Stratos.

5. Insert a check in the ***Import column data from old Template file*** check-box if you wish to set up the columns as per the data template file (TEM) that had been created along with the selected ATD file in the older version of the program. Click on the large open-file button to browse for the name of this Template file.

   Or, leave this box un-checked if you can't find the Template file or simply wish to set the column headers to consecutive numbers.
6. Click ***OK*** to continue.

The program will display the data in the Datasheet.

7. If the formatting (column titles or styles) needs adjusting, choose the **View** / **Columns** command.

! If you save this newly-formatted file, the column setup will now be saved in a "header" block in the ATD file. This will render it unusable in earlier versions of RockWorks unless you delete the header block.

See also Help / Contents / Reference / ATD File Format.

How to save a datasheet

Changes you have made to the data currently displayed in the RockWorks Utilities datasheet can be saved on disk using the **File** / **Save** or **Save As** command.

If the data file already has a name (as shown at the bottom of the program window), selecting **Save** will save the current version on disk, under the same name.

If the data file is untitled (as shown at the bottom of the program window), or if you choose **Save As**, the program will display a dialog box, in which you can specify the name under which the data file is to be saved.

1. ***File Name***: Type here the name to assign to the data file. Data files are stored with an ".atd" file name extension, for "ASCII Tab-Delimited" files.
2. Click ***Save***.

The program will save the information in the data window on disk, and the current name shown at the bottom of the program window will be updated as necessary.

RockWorks99 users: Column headings are no longer stored in the TEM files; they are stored right in the ATD file itself. RockWorks2004 no longer uses TEM files at all.

? Help / Contents / Reference / ATD File Format

How to print your datasheet

To output the data contained in RockWorks Utilities datasheet to your printer, select the File / Print command. You can set the columns to "Yes" (to print) or "No" (to omit from the print job): Use the Printer Setup button to access your printer settings.

? See Help / Contents / RockWorks Utilities / Entering Data / Using the Datasheet.

Laying Out Your Datasheet

The RockWorks Utilities datasheet in RockWorks is used to enter rows and columns of a variety of different kinds of data. This section discusses how to set up different kinds of data for use in the program, and how to change the column headings and column types.

! With a few exceptions, most of these data structures are flexible. In the examples provided, we have tried to illustrate the minimum required data as well as "typical" data layouts, but you can organize your data columns any way you wish. During processing you can always specify which spreadsheet columns contain what data.

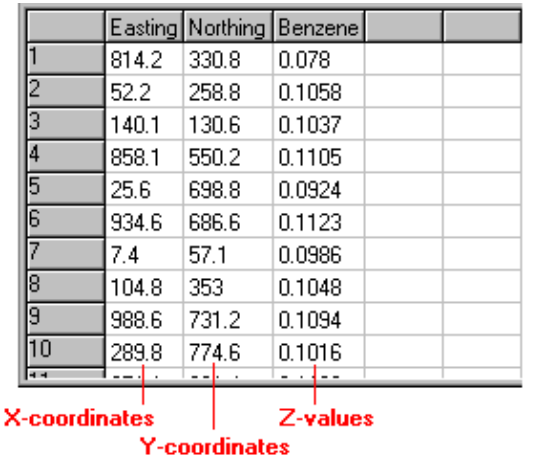
See also The Borehole Manager (page 39) regarding setting up downhole lithology, stratigraphy, geophysics, and other data.

? More information for all of these data structures is included in the RockWorks Searchable Help system. At the main program screen, select **Help** / **Contents**, and locate the "RockWorks Utilities / Entering Your Data" section.

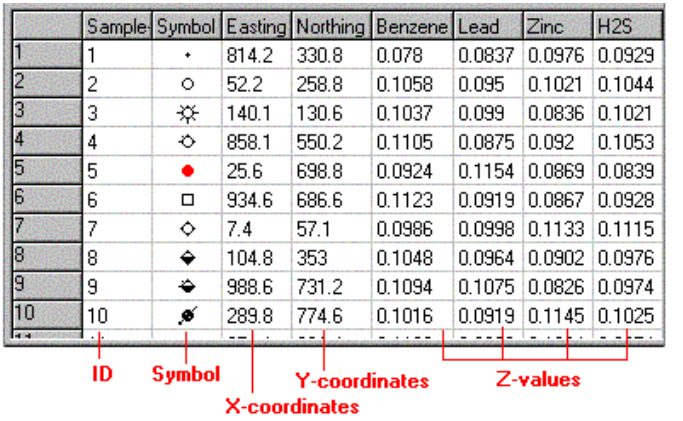
Data for Maps and General Diagrams

XYZ Data

"XYZ" data can be entered into the RockWorks Utilities datasheet to represent X and Y location coordinates and a measured "Z" value of some kind, such as elevations or geochemistry. This basic data layout can be run through **Map** / **EZ Map** to create a simple point map or line/color-filled contour map. Or, you can create a grid model of the XYZ data (**Map** / **Grid-Based Map**) for display as a 2D contour map or 3D surface.



	Easting	Northing	Benzene		
1	814.2	330.8	0.078		
2	52.2	258.8	0.1058		
3	140.1	130.6	0.1037		
4	858.1	550.2	0.1105		
5	25.6	698.8	0.0924		
6	934.6	686.6	0.1123		
7	7.4	57.1	0.0986		
8	104.8	353	0.1048		
9	988.6	731.2	0.1094		
10	289.8	774.6	0.1016		



	Sample	Symbol	Easting	Northing	Benzene	Lead	Zinc	H2S
1	1		814.2	330.8	0.078	0.0837	0.0976	0.0929
2	2		52.2	258.8	0.1058	0.095	0.1021	0.1044
3	3		140.1	130.6	0.1037	0.099	0.0836	0.1021
4	4		858.1	550.2	0.1105	0.0875	0.092	0.1053
5	5		25.6	698.8	0.0924	0.1154	0.0869	0.0839
6	6		934.6	686.6	0.1123	0.0919	0.0867	0.0928
7	7		7.4	57.1	0.0986	0.0998	0.1133	0.1115
8	8		104.8	353	0.1048	0.0964	0.0902	0.0976
9	9		988.6	731.2	0.1094	0.1075	0.0826	0.0974
10	10		289.8	774.6	0.1016	0.0919	0.1145	0.1025

! RockWorks offers a variety of data layout suggestions, but you can organize your data columns any way you wish. During processing you can always specify which column contains what data.

Sample files: XYelevations.atd

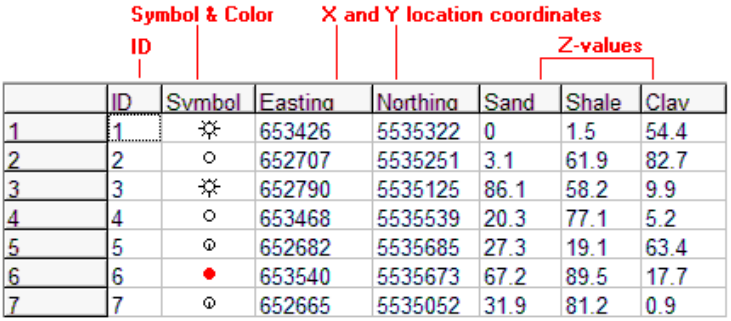
Template: When creating a new file (**File** / **New Datasheet** / Datasheet Column Titles), expand the ***Generic*** heading and select ***XYZ (Easting, Northing, Elevation)*** or ***XYZ (ID, Symbol, Easting, Northing, Elevation)***.

See Help / Contents / RockWorks Utilities / Entering Your Data / Laying Out Your Datasheet / XYZ Data.

Multivariate Data

"Multivariate" data can be entered into the RockWorks Utilities datasheet to list 2 or more components to be represented in a ternary diagram (**Stats** / **Ternary**, page 194), in a multi-variate map (**Maps** / **Multivariate** / **Pie**, **Barchart**, **Starburst**, page 105).

This example illlustrates how you might set up a date file to list different soil components. This file could be used with the **Stats** / **Ternary** option to illustrate the components in a ternary diagram.



	ID	Symbol	Easting	Northing	Sand	Shale	Clay
1	1	☼	653426	5535322	0	1.5	54.4
2	2	○	652707	5535251	3.1	61.9	82.7
3	3	☼	652790	5535125	86.1	58.2	9.9
4	4	○	653468	5535539	20.3	77.1	5.2
5	5	⊙	652682	5535685	27.3	19.1	63.4
6	6	●	653540	5535673	67.2	89.5	17.7
7	7	⊙	652665	5535052	31.9	81.2	0.9

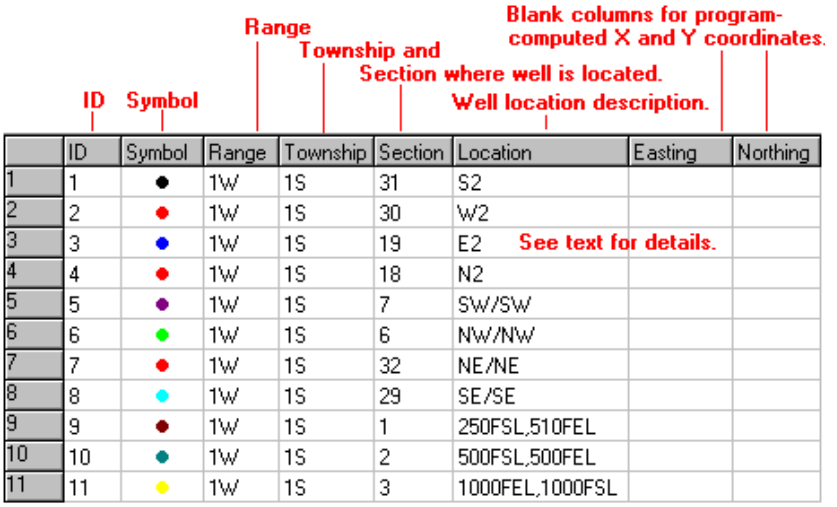
Sample Files: Soil Properties.atd for z-values representing soil components (sand, gravel, clay), geochemical measurements, and geotechnical parameters for use in a ternary diagram, display in maps, and more.

Template: When creating a new file (**File** / **New Datasheet** / Datasheet Column Titles), expand the ***Generic*** grouping and choose ***Ternary Diagram*** for a generic data layout. Or, expand the ***Civil Engineering*** heading and select ***Soil Classification***. Remember that you can change column names and column types easily using **View** / **Column Titles**.

See Help / Contents / RockWorks Utilities / Entering Your Data / Laying Out Your Datasheet / Multi-Variate Data.

Land Grid Well Descriptions

"Land Grid" well descriptions are entered into the RockWorks Utilities datasheet using a Range, Township, and Section notation format. RockWorks can compute (or "spot") X,Y location coordinates for these descriptions using a commercial or idealized reference land grid as reference (**Coords** / **Jeffersonial Points -> Cartesian**, page 116). Once the wells have X,Y location coordinates, their locations can be displayed in a point map (**Map** / **EZ Map**).



	ID	Symbol	Range	Township	Section	Location	Easting	Northing
1	1		1W	1S	31	S2		
2	2		1W	1S	30	W2		
3	3		1W	1S	19	E2		
4	4		1W	1S	18	N2		
5	5		1W	1S	7	SW/SW		
6	6		1W	1S	6	NW/NW		
7	7		1W	1S	32	NE/NE		
8	8		1W	1S	29	SE/SE		
9	9		1W	1S	1	250FSL,510FEL		
10	10		1W	1S	2	500FSL,500FEL		
11	11		1W	1S	3	1000FEL,1000FSL		

! Also required for translation of this type of well location description into X,Y is a "reference" land grid file that contains necessary section boundary coordinate information. These land grid data files must be created by you prior to spotting your wells, by importing commercial land grid data or creating an idealized land grid.

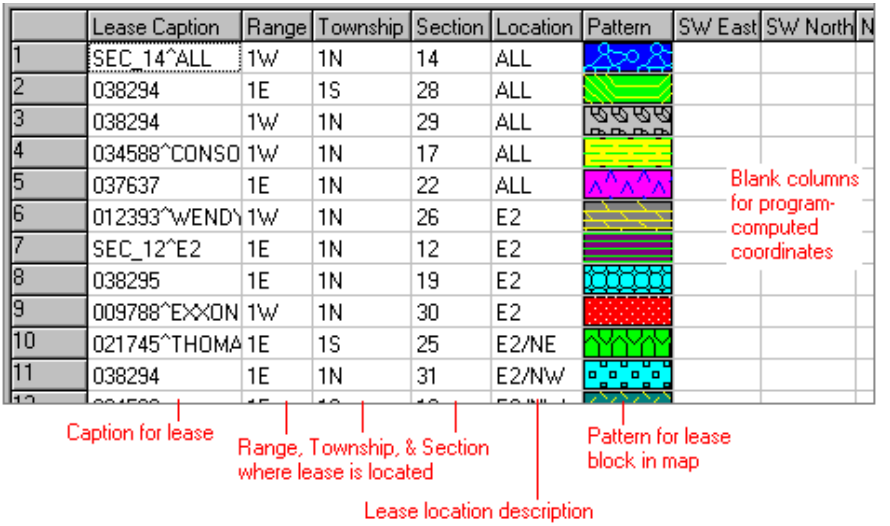
Sample files: Spot.atd.

Template: When creating a new file (**File** / **New Datasheet** / Datasheet Column Titles), expand the ***Jeffersonian Land Grid*** heading and select ***Congressional well locations***.

See Help / Contents / RockWorks Utilities / Entering Your Data / Laying Out Your Datasheet / Land Grid Well Descriptions.

Land Grid Lease Descriptions

"Land Grid Lease" descriptions are entered into the RockWorks Utilities datasheet using a Range, Township, and Section notation format. RockWorks can compute (or "spot") X,Y location coordinates for the lease corners using a commerical or idealized reference land grid as reference (**Coords** / **Jeffersonial Polygons -> Cartesian**, page 116). Once the leases have X,Y corner coordinates computed, their locations can be displayed in a lease map (**Map** / **Land Grid** / **Lease Map**).


Lease Caption
Range
Township
Section
Location
Pattern
SW East
SW North
1 SEC_14^ALL 1W 1N 14 ALL
2 038294 1E 1S 28 ALL
3 038294 1W 1N 29 ALL
4 034588^CONSO 1W 1N 17 ALL
5 037637 1E 1N 22 ALL
6 012393^WENDY 1W 1N 26 E2
7 SEC_12^E2 1E 1N 12 E2
8 038295 1E 1N 19 E2
9 009788^EXXON 1W 1N 30 E2
10 021745^THOMA 1E 1S 25 E2/NE
11 038294 1E 1N 31 E2/NW
Blank columns for program-computed coordinates
Caption for lease
Range, Township, & Section where lease is located
Lease location description
Pattern for lease block in map

! Also required for translation of this type of lease description into X,Y is a "reference" land grid file that contains necessary section boundary coordinate information. These land grid data files must be created by you prior to spotting your lease blocks, by importing commercial land grid data or creating an idealized land grid.

Sample files: LeaseMap.atd.

Template: When creating a new file (**File** / **New Datasheet** / Datasheet Column Titles), expand the ***Jeffersonian Land Grid*** heading and select ***Leases***.

See Help / Contents / RockWorks Utilities / Entering Your Data / Laying Out Your Datasheet / Land Grid Lease Descriptions.

Other Map Data

Please refer to the Help messages for formatting details for these data types:

- Survey (Bearing, Distance) Data
- Survey (Triangulation) Data
- Shotpoint Data
- Global Map Point Data
- Global Map Polyline Data
- Google Earth Point, Polygon, and Polyline Data

Grid Model Lists

Stratigraphy Grid Lists

These files are used to build a 3D stratigraphic fences, models, and stacked surfaces from existing grid models. They are used in the RockWorks Utilities **Grid** / **Grids -> Stratigraphic Fence**, **Grids -> Stratigraphic Model**, and **Grids -> Stacked Surfaces** options.

Title	Superface	Subface	Color	Cutoff
Unit 1	Unit_1_Top.grd	Unit_1_Base.grd		1.0
Unit 2	Unit_2_Top.grd	Unit_2_Base.grd		0.5
Unit 3	Unit_3_Top.grd	Unit_3_Base.grd		0.5
Unit 4	Unit_4_Top.grd	Unit_4_Base.grd		1.0
Unit 5	Unit_5_Top.grd	Unit_5_Base.grd		2.0
Unit 6	Unit_6_Top.grd	Unit_6_Base.grd		2.0
Unit 7	Unit_7_Top.grd	Unit_7_Base.grd		1.5
Unit 8	Unit_8_Top.grd	Unit_8_Base.grd		0.5
Unit 9	Unit_9_Top.grd	Unit_9_Base.grd		1.0
Unit 10	Unit_10_Top.grd	Unit_10_Base.grd		0.5

!! When creating the list of units, be sure to list them in reverse order (with the lowest stratigraphic unit at the top of the listing to highest stratigraphic unit at the bottom of the listing). This convention is due to a restriction within the OpenGL environment.

!! All of the GRD models must have the same dimensions and node spacing in order for the program to be able to build the stratigraphic diagrams. They must also reside in the same project folder as the ATD file.

Sample file: gridlist.atd

Template: When creating a new file (**File** / **New Datasheet** / Datasheet Column Titles), expand the ***Stratigraphy*** heading and select ***Grid Lists***.

See Help / Contents / RockWorks Utilities / Entering Your Data / Laying Out Your Datasheet / Grid Lists.

Other Lists

Please refer to the Help messages for formatting details for these data types:

- Multi-Variate Anomaly Grid Lists
- Grid to Logs Lists

Data for Solid Models

XYZG Data

"XYZG" data can be entered into the RockWorks Utilities datasheet to represent X, Y, and Z location coordinates (easting, northing, and elevation) and a measured "G" value of some kind, such as geochemistry or geophysical measurements. This basic data layout can be run through **Solid** / **Model** for display as a 3-dimensional isosurface or block diagram.

! Use the Borehole Manager instead of the RockWorks Utilities datasheet if you have multiple downhole measurements for each well. See Entering the Borehole Data (page 39).

Example 1: This example shows how you might enter X,Y,Z,G data into the RockWorks Utilities datasheet for modeling.

	X	Y	Z	G
1	8.2	10.6	2.3	70.7
2	94.9	66.7	57.2	7.6
3	27.9	22.7	6.0	32.1
4	40.3	83.2	1.4	62.5
5	15.9	20.5	61.3	19.4
6	69.5	68.5	23.1	82.9
7	81.9	76.3	21.8	84.9
8	12.7	85.2	65.5	99.5
9	77.8	60.0	74.8	27.1
10	19.1	2.8	3.1	17.7
11	22.7	84.0	9.2	54.6

X (easting), Y (northing), and Z (elevation) points in space.

measured G values at those points

Example 2: RockWorks can also create a solid model from a separate ASCII XYZG file. In this case, no data is read from the RockWorks Utilities datasheet. Such a file can be exported from many software programs. See the Help file for details.

Sample files: = XYZG.atd

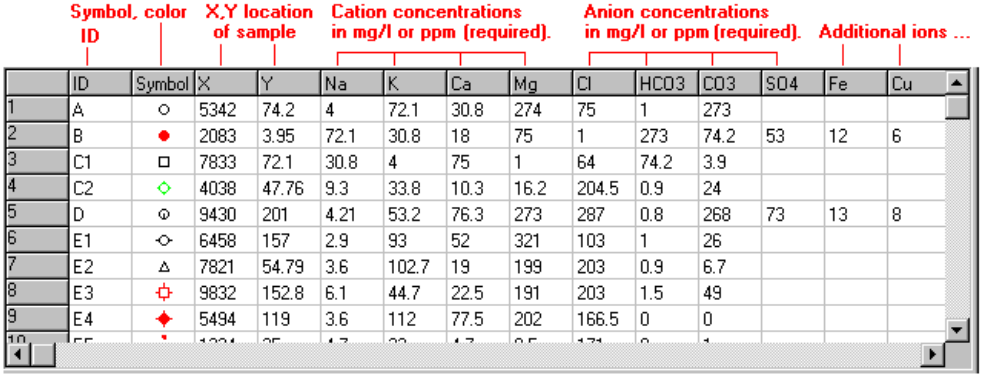
Template: When creating a new file (**File** / **New Datasheet** / Datasheet Column Titles), expand the ***Generic*** heading and select ***XYZG***.

See Help / Contents / RockWorks Utilities / Entering Your Data / Laying Out Your Datasheet / XYZG Data. .

Hydrology/Hydrochemistry Data

Hydrochemistry (Ion) Data

Anion and cation concentrations can be entered into the RockWorks Utilities datasheet for the purposes of creating Piper diagrams, Stiff diagrams, Durov plots, computing total dissolved solids, and/or ion balances (**Hydrochemistry** menu, page 183). These "hydrochemistry" files list cation and anion concentrations in parts per million (or milligrams per liter). There are 4 required cations and 4 required anions; additional cations and anions may be included as you wish.


Symbol, color ID
X,Y location of sample
Cation concentrations in mg/l or ppm (required).
Anion concentrations in mg/l or ppm (required).
Additional ions ...

	ID	Symbol	X	Y	Na	K	Ca	Mg	Cl	HCO3	CO3	SO4	Fe	Cu
1	A		5342	74.2	4	72.1	30.8	274	75	1	273			
2	B		2083	3.95	72.1	30.8	18	75	1	273	74.2	53	12	6
3	C1		7833	72.1	30.8	4	75	1	64	74.2	3.9			
4	C2		4038	47.76	9.3	33.8	10.3	16.2	204.5	0.9	24			
5	D		9430	201	4.21	53.2	76.3	273	287	0.8	268	73	13	8
6	E1		6458	157	2.9	93	52	321	103	1	26			
7	E2		7821	54.79	3.6	102.7	19	199	203	0.9	6.7			
8	E3		9832	152.8	6.1	44.7	22.5	191	203	1.5	49			
9	E4		5494	119	3.6	112	77.5	202	166.5	0	0			

Sample files: HydroChem.atd

Template: When creating a new file (**File** / **New Datasheet** / Datasheet Column Titles), expand the ***Hydrology/Hydrogeology*** heading and select ***Hydrochemistry***.

See Help / Contents / RockWorks Utilities / Entering Your Data / Laying Out Your Datasheet / Hydrochemistry data.

Other Data

Please refer to the Help messages for formatting details for these data types:

- Drawdown Data
- Hydrograph Data

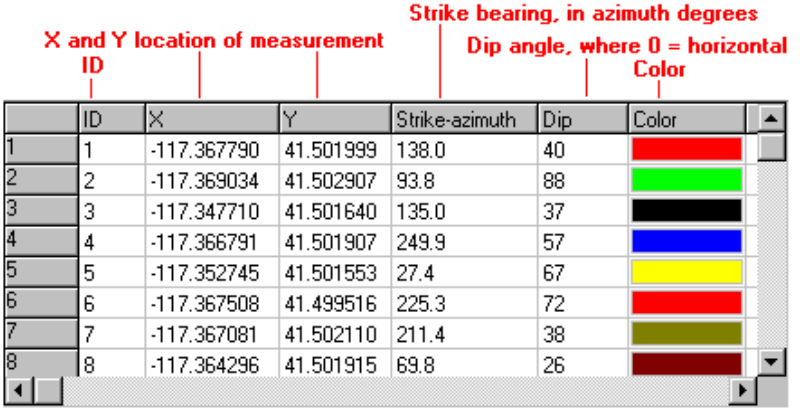
Planar and Linear Data

Strike and Dip Data

Strike and dip measurements can be entered into the RockWorks Utilities datasheet for the purposes of creating strike and dip maps, rose diagrams (bearings only), stereonet

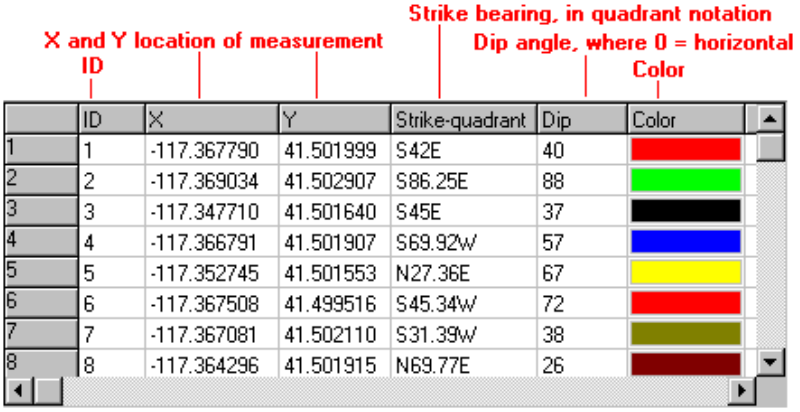
diagrams, and of computing planar intersections (see Chapter 14). There are a variety of ways you can structure these files, depending on your desired output.

Example 1: This example lists site-specific strike and dip measurements, with strike shown in azimuth bearings. These data could be displayed as a strike and dip map, stereonet diagram, rose diagram (using azimuth only), or computed for planar intersections.



	ID	X	Y	Strike-azimuth	Dip	Color
1	1	-117.367790	41.501999	138.0	40	
2	2	-117.369034	41.502907	93.8	88	
3	3	-117.347710	41.501640	135.0	37	
4	4	-117.366791	41.501907	249.9	57	
5	5	-117.352745	41.501553	27.4	67	
6	6	-117.367508	41.499516	225.3	72	
7	7	-117.367081	41.502110	211.4	38	
8	8	-117.364296	41.501915	69.8	26	

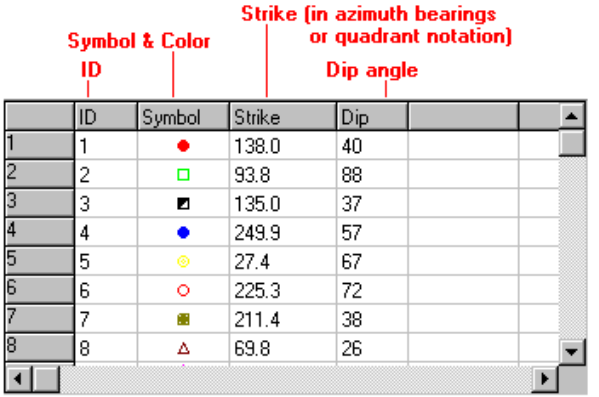
Example 2: This example lists site-specific strike and dip measurements, with strike shown in *quadrant* format.



	ID	X	Y	Strike-quadrant	Dip	Color
1	1	-117.367790	41.501999	S42E	40	
2	2	-117.369034	41.502907	S86.25E	88	
3	3	-117.347710	41.501640	S45E	37	
4	4	-117.366791	41.501907	S69.92W	57	
5	5	-117.352745	41.501553	N27.36E	67	
6	6	-117.367508	41.499516	S45.34W	72	
7	7	-117.367081	41.502110	S31.39W	38	
8	8	-117.364296	41.501915	N69.77E	26	

! Note that the dip angle must NOT include any directional notation.

Example 3: This example lists strike and dip measurements with no X,Y location coordinates. This setup could be used to create stereonets and/or rose diagrams, with symbols for the sample sites (used in Stereonet only).



	ID	Symbol	Strike	Dip
1	1	●	138.0	40
2	2	□	93.8	88
3	3	◩	135.0	37
4	4	●	249.9	57
5	5	◎	27.4	67
6	6	○	225.3	72
7	7	▣	211.4	38
8	8	△	69.8	26

Sample files: Planes.atd.

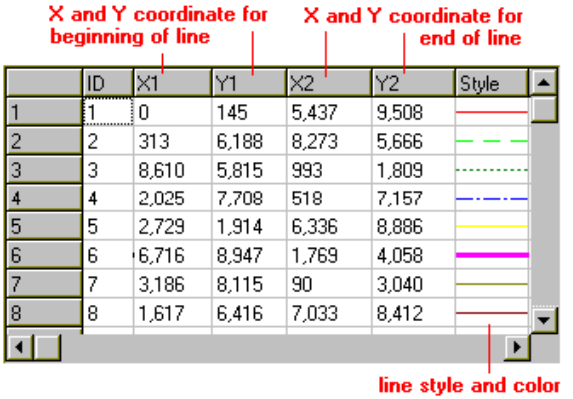
Template: When creating a new file (**File** / **New Datasheet** / Datasheet Column Titles), expand the ***Structural Geology*** heading and select ***Strikes and Dips***.

Help / Contents / RockWorks Utilities / Entering Your Data / Laying Out Your Datasheet / Strike and Dip data.

Lineation Endpoint Data

Lineation endpoint data can be entered into the RockWorks Utilities datasheet for the purposes of computing lineation azimuth/midpoint/lengths and lineation densities & intersections, and for creating rose diagrams, lineation maps, and arrow maps (**Linears** menu, see Chapter 14).

Example:



	ID	X1	Y1	X2	Y2	Style
1	1	0	145	5,437	9,508	
2	2	313	6,188	8,273	5,666	
3	3	8,610	5,815	993	1,809	
4	4	2,025	7,708	518	7,157	
5	5	2,729	1,914	6,336	8,886	
6	6	6,716	8,947	1,769	4,058	
7	7	3,186	8,115	90	3,040	
8	8	1,617	6,416	7,033	8,412	

Sample file: Lines.atd

Template: When creating a new file (**File** / **New Datasheet** / Datasheet Column Titles), expand the ***Structural Geology*** heading and select ***Lineation Endpoints*** for a simple X1Y1X2Y2 layout, or ***Colored Lineations*** for a setup that will also include an ID and linestyle column.

See Help / Contents / RockWorks Utilities / Entering Your Data / Laying Out Your Datasheet / Lineation Data.

See also: Digitizing data (page 98) for information about digitizing line endpoint data directly into the datasheet. Movement Data structure (below) for X1Y1X2Y2 data that also have elevation and time measurements associated with them, for movement analysis.

Other Data

Please refer to the Help messages for formatting details for these data types:

- Beta Pairs Data
- Movement Data

3D Graphic Data

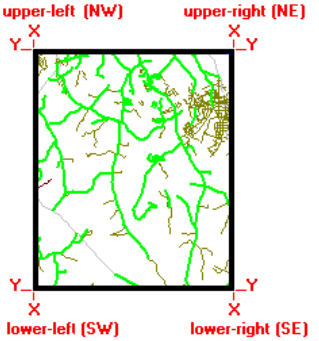
These files are read by the tools in the **Grafix** / **3D Utilities** menu.

Horizontal Panel Image Lists

These files are used to display one or more raster images (BMP, JPG, TIFF, PNG, AFI, VST, PCX, PCC, EMF and WMF) as non-vertical panels in RockPlot3D. (See **Grafix** / **3D Utilities** / **Images** / **Panels** / **Horizontal**, page 200.) This program requires 14 columns of information: The names of the images to be displayed in the OpenGL panels, their layer name, and the X, Y, and Z coordinates for each corner.

Example:

Layer Na	File Name	SW X	SW Y	SW Z	NW X	NW Y	NW Z	NE X	NE Y	NE Z	SE X	SE Y	SE Z
Layer 1	layer_01.jpg	652967.0	5535293.0	1478.0	652967.0	5,536,543.0	132.0	654,217.0	5536543.0	132.0	654217.0	5535293.0	132.0
Layer 2	layer_02.jpg	653238.0	5535554.0	1480.0	653238.0	5,536,804.0	183.0	654,488.0	5536804.0	183.0	654488.0	5535554.0	183.0
Layer 3	layer_03.jpg	652899.0	5535620.0	1484.0	652899.0	5,536,870.0	171.0	654,149.0	5536870.0	171.0	654149.0	5535620.0	171.0
Layer 4	layer_04.jpg	653238.0	5535293.0	1480.0	653238.0	5,536,543.0	229.0	654,488.0	5536543.0	229.0	654488.0	5535293.0	229.0
Layer 5	layer_05.jpg	653103.0	5535424.0	1480.0	653103.0	5,536,674.0	142.0	654,353.0	5536674.0	142.0	654353.0	5535424.0	142.0



! OpenGL vertical panels are assumed to be vertical and coordinates for only two corners are required. By contrast, RockWorks allows you to enter X, Y, and elevation coordinates for *each corner* of these "horizontal" panels. Thus, these panels are not required to be horizontal.

Sample file: Mine Level Bitmaps.atd which reference these bitmaps: gold_1450.bmp, gold_1400.bmp, and gold_1350.bmp.

Template: When creating a new file (**File** / **New Datasheet** / Datasheet Column Titles), expand the ***Grafix3D*** heading and select ***Horizontal Image Panels***.

See Help / Contents / RockWorks Utilities / Entering Your Data / Laying Out Your Datasheet / Horizontal Panel Image Lists.

Vertical Panel Image Lists

These files are used to display one or more raster images (BMP, JPG, TIFF, PNG, AFI, VST, PCX, PCC, EMF and WMF) as 3-dimensional panels in RockPlot3D. (See **Grafix** / **3D Utilities** / **Images** / **Panels** / **Vertical**, page 200.) This program requires 8 columns of information: The names of the images to be displayed in the OpenGL panels, their layer name, and the X, Y, and Z coordinates for the lower-left and upper-right corners of the bitmap image.

Example:

Row#	Image Name	Layer Name	X Lower-left	Y Lower-left	Z Lower-left	X Upper-right	Y Upper-right	Z Upper-right
1	gpr_south.jpg	GPR south	0	0	0	1000	0	250
2	gpr_north.jpg	GPR north	0	1000	0	1000	1000	250
3	gpr_west.jpg	GPR west	0	0	0	0	1000	250
4	gpr_east.jpg	GPR east	1000	0	0	1000	1000	250

image name — name for item in RockPlot3D — X (Easting), Y (Northing), and Z (elevation) for lower-left corner of image. — X (Easting), Y (Northing), and Z (elevation) for upper-right corner of image.

Sample file: GPRpanels.atd which reference these bitmaps: GPR_south.jpg, GPR_north.jpg, GPR_west.jpg, and GPR_east.jpg.

Template: When creating a new file (**File** / **New Datasheet** / Datasheet Column Titles), expand the ***Grafix 3D*** heading and select ***Vertical Image Panels***.

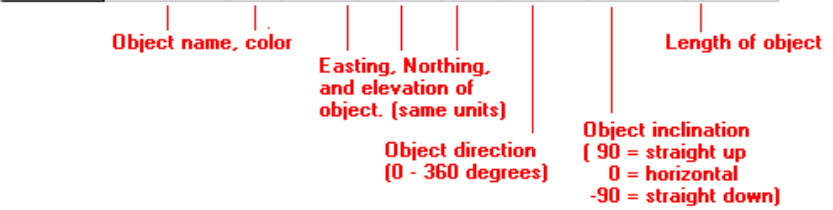
Help / Contents / RockWorks Utilities / Entering Your Data / Laying Out Your Datasheet / Vertical Panel Image Lists.

3D Oriented Objects

These files are used to build a 3D image containing cone shapes at specific XYZ locations, with a declared bearing and inclination. (See **Grafix** / **3D Utilities** / **Oriented Objects**, page 200.) This program requires 7 columns of information: The object name, color, X, Y, and Z coordinates, bearing, and inclination. The Length column is optional.

Example:

	Name	Color	X	Y	Z	Direction	Inclination	Length
1	Arrowhead		653530	5535361	1463	345	-38	1
2	Spear Tip		653542	5535433	1407	309	83	2
3	Bullet		653484	5535361	1353	252	88	3
4	Brachiopod		652939	5535939	1353	342	-67	4
5	Spear Tip		653600	5535970	1373	154	7	5
6	Belemnite		653217	5535918	1247	73	79	6
7	Brachiopod		653519	5535454	1467	231	-80	7
8	Belemnite		652811	5535175	1373	311	48	8
9	Arrowhead		653507	5535908	1303	278	61	9
10	Bullet		653159	5535495	1480	171	-27	10
11	Belemnite		653507	5535124	1297	48	2	11
12	Spear Tip		653055	5535867	1500	57	11	12
13	Brachiopod		652776	5535031	1367	74	13	13


Object name, color
Easting, Northing, and elevation of object. (same units)
Object direction (0 - 360 degrees)
Object inclination (90 = straight up 0 = horizontal -90 = straight down)
Length of object

Sample file: Fossils.atd.

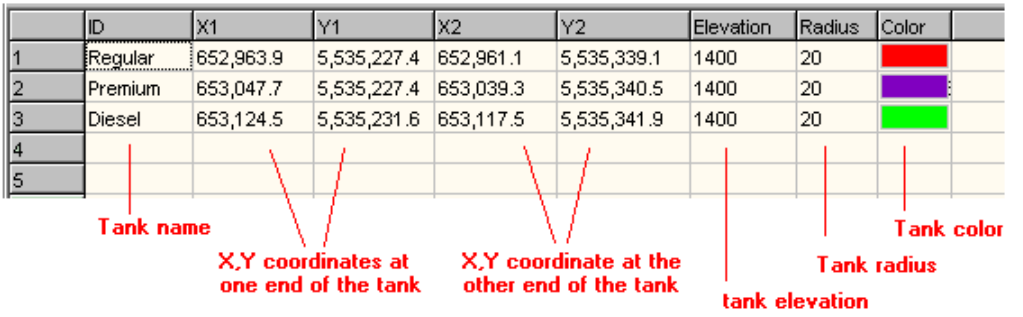
Template: When creating a new file (**File** / **New Datasheet** / Datasheet Column Titles), expand the ***Grafix 3D*** heading and select ***3D Oriented Samples***.

See Help / Contents / RockWorks Utilities / Entering Your Data / Laying Out Your Datasheet / Oriented Objects Data Format.

Horizontal Tanks

These files are used to build a 3D image containing horizontal cylinders at specific XYZ locations, with a declared radius and color. (See **Grafix** / **3D Utilities** / **Storage Tanks** / **Horizontal**, page 201.) This program requires 8 columns of information: The object name, X and Y location of one end of the tank, X and Y coordinate for the other end of the tank, tank elevation, radius, and color.

Example:



Sample file: buried tanks.atd.

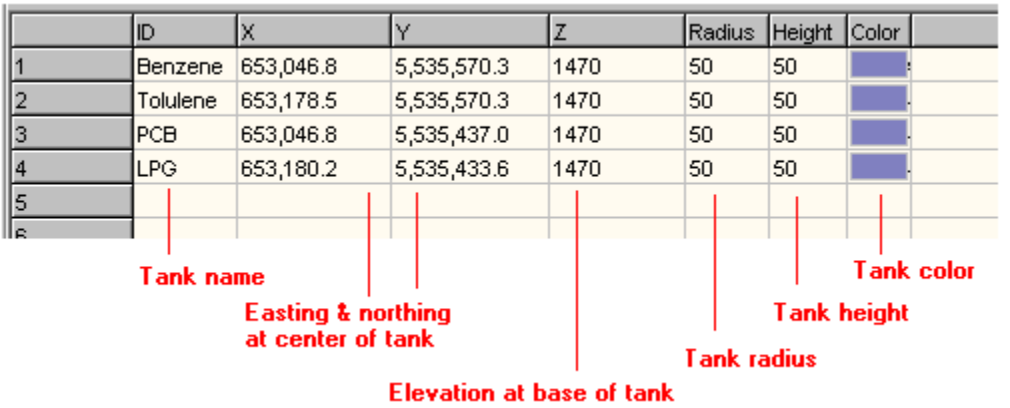
Template: When creating a new file (**File** / **New Datasheet** / Datasheet Column Titles), expand the ***Grafix 3D*** heading and select ***Horizontal Storage Tanks***.

See Help / Contents / RockWorks Utilities / Entering Your Data / Laying Out Your Datasheet / Horizontal Tanks Data Format.

Vertical Tanks

These files are used to build a 3D image containing vertical cylinders at specific XYZ locations, with a declared radius, height and color. (See **Grafix** / **3D Utilities** / **Storage Tanks** / **Vertical**, page 201.) This program requires 8 columns of information: The object name, X Y Z location of the tank, radius, height, and color.

Example:



Sample file: Surface tanks.atd.

Template: When creating a new file (**File** / **New Datasheet** / Datasheet Column Titles), expand the ***Grafix 3D*** heading and select ***Vertical Storage Tanks***.

See Help / Contents / RockWorks Utilities / Entering Your Data / Laying Out Your Datasheet / Vertical Tanks Data Format.

Other Data

Please refer to the Help messages for formatting details for these data types:

- 3D Discs
- 3D Cube Image Lists
- 3D Spheres
- Surface Objects (buildings, etc.)
- 3D Triangles
- 3D Tubes

Editing the Datasheet

Editing the Datasheet - Overview

This section summarizes some of the tools used to modify the contents of the RockWorks Utilities datasheet in RockWorks.

More complete information can be found in the on-line help. See Help / Contents / RockWorks Utilities / Entering Your Data / Datasheet Mechanics.

Changing Column Titles and Styles

Change a data column title

To change the name of a column in the current RockWorks Utilities datasheet, follow these steps:

1. Access the RockWorks Utilities datasheet.
2. Select the **View** / **Columns** command.

The "Title" column in the Column Settings window lists the column names. The names listed here are also displayed in the gray heading cells at the top of the datasheet.

3. Left-click in the cell containing the title to be changed to highlight the existing text.
4. Type in the new text for the column title.

   ! You should limit the column names to 20 characters, including spaces.

5. Repeat this process for as many columns as you wish in the scrolling list, by clicking in each cell and typing a new name.

Change the Column Type

The column "type" determines how the information in a RockWorks Utilities datasheet column will be displayed or how it will "behave": as text, graphic symbols, graphic lines, graphic patterns, a hyperlink to a file, and so on.

To change the column type, follow these steps:

1. Access the RockWorks Utilities datasheet.
2. Select the **View** / **Columns** command.

   The "Data Type" column in the Column Settings window lists the column types.

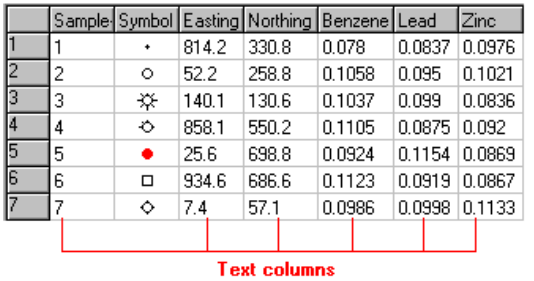
3. Left-click in the Data Type cell for the column to be changed.

   The program will display a pop-up window that lists all of the available column types.

4. Select the data column's type by clicking in the appropriate selection.

   Text columns display their contents as textual characters, both alphabetic and numeric.

   > Most of your columns will probably be set to ***Text*** columns, including X and Y location coordinates, any sample ID’s, measured data values, and other project information. Text columns simply display their contents as letters and numbers.

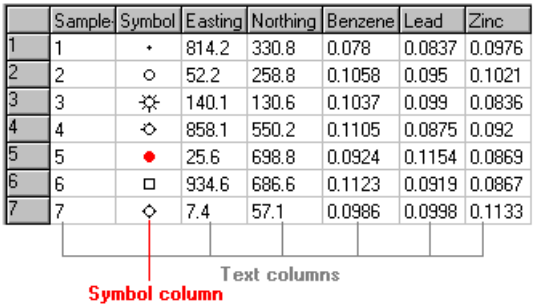


	Sample	Symbol	Easting	Northing	Benzene	Lead	Zinc
1	1		814.2	330.8	0.078	0.0837	0.0976
2	2		52.2	258.8	0.1058	0.095	0.1021
3	3		140.1	130.6	0.1037	0.099	0.0836
4	4		858.1	550.2	0.1105	0.0875	0.092
5	5		25.6	698.8	0.0924	0.1154	0.0869
6	6		934.6	686.6	0.1123	0.0919	0.0867
7	7		7.4	57.1	0.0986	0.0998	0.1133

You may also display symbols, colors, lines, and patterns as text if you prefer not to see their graphic display.

Symbol columns display the contents of the column as graphic symbols, in a user-selected color.

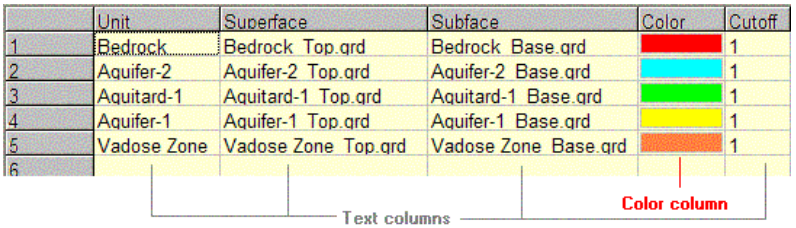
Datasheet columns that you set as ***Symbol*** columns are used to display actual symbol designs and colors that you have selected for each well or sample site.



	Sample	Symbol	Easting	Northing	Benzene	Lead	Zinc
1	1		814.2	330.8	0.078	0.0837	0.0976
2	2		52.2	258.8	0.1058	0.095	0.1021
3	3		140.1	130.6	0.1037	0.099	0.0836
4	4		858.1	550.2	0.1105	0.0875	0.092
5	5		25.6	698.8	0.0924	0.1154	0.0869
6	6		934.6	686.6	0.1123	0.0919	0.0867
7	7		7.4	57.1	0.0986	0.0998	0.1133

To select a symbol simply double-click in the appropriate cell in the datasheet's Symbol column, and select a symbol from the displayed list.

Color columns display the contents of the column as a block of color.



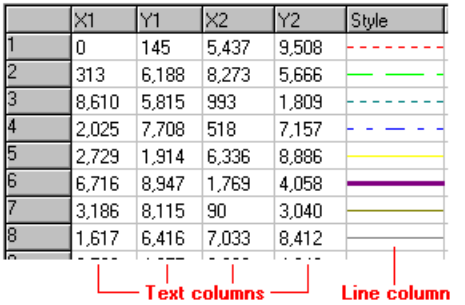
	Unit	Superface	Subface	Color	Cutoff
1	Bedrock	Bedrock_Top.grd	Bedrock_Base.grd		1
2	Aquifer-2	Aquifer-2_Top.grd	Aquifer-2_Base.grd		1
3	Aquitard-1	Aquitard-1_Top.grd	Aquitard-1_Base.grd		1
4	Aquifer-1	Aquifer-1_Top.grd	Aquifer-1_Base.grd		1
5	Vadose Zone	Vadose Zone_Top.grd	Vadose Zone_Base.grd		1
6					

To select a color simply double-click in the appropriate cell in the datasheet's Color column, and select a color from the displayed list.

Line columns display the contents of the column as graphic lines in a user-selected color.

Datasheet columns that you set as ***Line*** columns are used to select a line style and

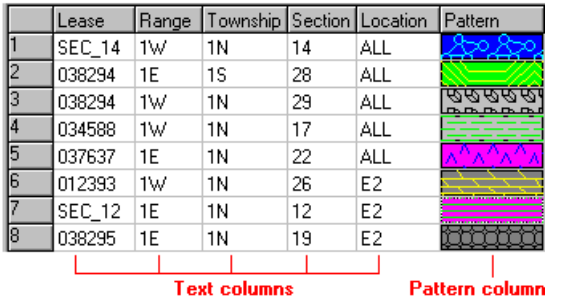
thickness for each sample listed in rows in the main datasheet. The actual line styles and colors are displayed in the column. These are typically used when plotting lineation or arrow maps (**Linears** menu).



To select a line style and color, simply double-click in the appropriate cell in the datasheet's Line column, and select a line style and width from the displayed list.

Pattern columns display the contents of the column as a graphic pattern.

Datasheet columns that you set as ***Pattern*** columns are used to display actual pattern designs and colors that you have selected for each sample or row in the datasheet. These are often used in lease boundary files to declare a particular pattern with which to fill the lease area in a map.


Lease Range Township Section Location Pattern
1 SEC_14 1W 1N 14 ALL
2 038294 1E 1S 28 ALL
3 038294 1W 1N 29 ALL
4 034588 1W 1N 17 ALL
5 037637 1E 1N 22 ALL
6 012393 1W 1N 26 E2
7 SEC_12 1E 1N 12 E2
8 038295 1E 1N 19 E2
Text columns
Pattern column

To select a pattern simply double-click in the appropriate cell in the datasheet's Pattern column, and select a pattern and colors from the displayed list.

File columns are used to list file names, such as grid models, images, or other files to be processed within the program.

Setting a column to a “File” type will cause the program to display an open-file dialog if the user double-clicks on the cell. This capability provides a useful method for browsing for file names when setting up datasheets for program such as the **Grafix** / **3D-Utilities** / **Images** / **Panels** / **Vertical** application.

Note that file names can also be listed in basic Text-style columns.

Hyperlink columns are also used to list file names, such as grid models, images, or

other files to be processed within the program.

In contrast to “File” columns (above) which display a browse window when you double-click in a cell, Hyperlink columns will actually load the file into whatever Windows application is associated with the file name. For example, double-clicking on a file ending with ".JPG" might load the file into a bitmap editor.

5. Repeat this process for as many columns as you wish in the scrolling list, by clicking in each cell and choosing a type.

RockWorks99 users: Wondering where the Curve, Histogram, Lithology, and Zone columns went? These data are now entered in the Borehole Manager. See Entering the Borehole Data (page 39) for details.

Other Data Editing Tools

Edit menu:

Delete: Deletes the contents of the highlighted cell(s) in the current datasheet. The contents are not placed on the computer's clipboard memory; they are just deleted.

Cut All: Removes the entire contents of the current datasheet, placing the contents in the computer's clipboard memory for later pasting. This is the same operation as would occur if you were to hand-select all of the cells in the current datasheet and then select the **Edit** / **Cut** command.

Copy All: Places a copy of the entire contents of the current datasheet in the clipboard memory for later pasting. This is the same operation as would occur if you were to hand-select all of the cells in the current datasheet and then select the **Edit** / **Copy** command.

Paste All: Replaces the current datasheet with the contents of the clipboard.

Cut All: Removes the entire contents of the current datasheet, placing the contents in the computer's clipboard memory for later pasting. This is the same operation as would occur if you were to hand-select all of the cells in the current window and then select the **Edit** / **Cut** command.

Copy All: Places a copy of the entire contents of the current datasheet in the clipboard memory for later pasting. This is the same operation as would occur if you were to hand-select all of the cells in the current window and then select the **Edit** / **Copy** command.

Columns / **Insert**: Inserts a new, blank column in the active datasheet.

Columns / **Delete**: Deletes one or more columns from the active datasheet.

Columns / **Math**: Performs simple arithmetic operations on the values within a selected column in the current datasheet.

Columns / **Merge**: Merges the contents of two columns in the active datasheet, with a user-specified separator.

Columns / **Increment**: Lists numeric values in a column, incrementing the values by the real number you declare.

Columns / **Combine**: Used to combine symbol + color columns or linestyle + color columns, in the RockWorks Utilities datasheet only.

Columns / Statistics: Used to compute basic statistics (range, mean, standard deviation, etc.) for a single column of values in the datasheet.

Columns / Filter: Used to filter out data values that fall outside a user-defined range.

Columns / **Fix**: Strips out commas, tabs and spaces from numeric values in a selected column.

Rows / **Insert**: Inserts a user-specified number of rows above the currently active row in the datasheet, offering the user the option to change the default row number.

Rows / **Delete**: Deletes a user-specified number of rows in the current datasheet, offering the option to change the default row number.

Rows / **Go to**: Advances to a specific row in the current datasheet.

Rows / **Sort**: Sorts the rows in the current datasheet based on a selected column of values.

Digitize / Points: If you have a tablet digitizer and driver installed, you can digitize depths and values from a paper curve trace into the current data window.

Digitize / Lines: If you have a tablet digitizer and driver installed, you can digitize line endpoints into the current data window.

Filter: Filters data from the current datasheet based on settings for 1 to 5 columns.

Random / Completely Random: Generates a list of completely random numbers in the selected datasheet column, based on a user-specified value range.

Random / Normal Distribution: Generates as list of random numbers in the selected datasheet column. These random numbers will comply with a normal distribution, based on the user-declared value range.

Refresh: Forces the program to redraw the contents of the current datasheet, in case recent changes are not represented.

View menu

Find Closest Point: Use this tool to enter a known X and Y coordinate and to locate the data record in the RockWorks Utilities window that is closest to that point.

Odd Numbered Row Color: Use this tool to select the color in which the odd numbered rows in the RockWorks Utilities window will be displayed.

Even Numbered Row Color: Use this tool to select the color in which the even numbered rows in the RockWorks Utilities window will be displayed.

Importing Data

Many of you will enter your data right within the RockWare program's RockWorks Utilities datasheet, by typing directly from the keyboard, or by cutting and pasting data from another document.

Another method of getting data into the program is to import data from other applications or commercial sources. The following import tools are available; see these Help topics:

Help / Contents / RockWorks Utilities / Entering Your Data / Importing Data /…

Importing ASCII Data into the Datasheet.
Importing DBF Files into the Datasheet.
Extracting XYZ Coordinates from DXF Files
Extracting XYZ Coordinates from DXF into ASCII files
Importing DXF Lineations into the Datasheet
Importing Garmin GPS Data
Importing Geonics Conductivity Data
Importing DeLorme Data.
Importing GSM-19 Magnetometer Data.
Importing Laser Atlanta Data.
Importing ModPath Pathline Data.
Importing NEIC Earthquake Data
Importing RockBase Data.
Importing SEG-P1 Shotpoint Data.
Importing Tobin WCS Data.
Importing XLS (Excel) Data.

Exporting Data from the RockWorks Utilities Datasheet

If you wish to export the data contained in the RockWorks Utilities datasheet, use the **File** / **Export** command. It offers export as a text file, a DBF-format file, or a Microsoft Excel (XLS) file. See these Help topics:

Help / Contents / RockWorks Utilities / Entering Your Data / Exporting Data / …

Exporting the Datasheet to ASCII Format
Exporting the Datasheet to DBF Format
Exporting the Datasheet to XLS Format

Transferring Data to the Borehole Manager

Use the **File** / **Transfer** tools to transfer the following data from the RockWorks Utilities to the Borehole Manager:

Locations -> Borehole Files: This tool reads specific data fields from the RockWorks Utilities datasheet and records them in the Borehole Manager Location tabs. This can be

useful if you have done some coordinate manipulation in the RockWorks Utilities and want the new coordinates to be represented in the Borehole Manager's BH files. Or, this can also be a handy way to start a new set of BH files with location information for a new project.

Stratigraphy -> Borehole Files: This tool reads specific data fields from the RockWorks Utilities datasheet and records them in the Borehole Manager Stratigraphy tabs. This can be useful if you have done some manipulation of the stratigraphic elevations in the RockWorks Utilities and want the modified data to be represented in the Borehole Manager.

Help / Contents / RockWorks Utilities / Entering Your Data / Transferring Data to the Borehole Manager.

Digitizing Data

RockWorks offers two tools in the **Edit** menu that permit you to use an electronic digitizing tablet to enter either X and Y point data or line endpoints directly into the RockWorks Utilities datasheet. In this way, you can enter your sample site location coordinates or lineation endpoint coordinates directly off of a paper map.

The digitizing tool is also available in the Polygon Vertices editor (see page 268).

! In order to use the digitizing capability of the program, you must have an electronic digitizer attached to your computer and a Windows "driver" for the digitizer installed on your computer. These drivers are supplied by the digitizer manufacturer. You must also be sure that you have correctly set up your digitizing tablet. If there is no communication between the digitizer and your computer, you aren't going to be able to digitize any points!

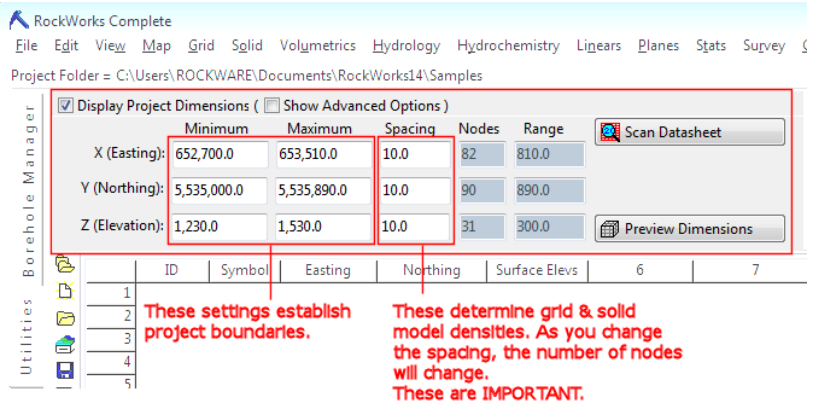
See also: Digitizing Data from Bitmaps (page 203), and RockPlot2D Digitizing Tools (page 219).

Help / Contents / RockWorks Utilities / Entering Your Data / Digitizing Data.

Viewing and Setting Your Project Dimensions

The Project Dimensions define for the program the boundary coordinates of your project, and the spacing of the nodes for grid and solid models, which can apply universally to the current project.

The current Project Dimensions can be viewed at the top of the RockWorks Utilities display by inserting a check in the Display Project Dimensions box:

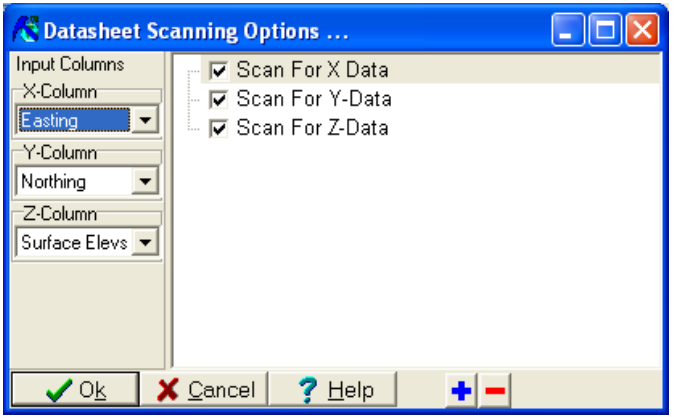

RockWorks Complete
File Edit View Map Grid Solid Volumetrics Hydrology Hydrochemistry Linears Planes Stats Survey
Project Folder = C:\Users\ROCKWARE\Documents\RockWorks14\Samples
Display Project Dimensions (Show Advanced Options)
Minimum Maximum Spacing Nodes Range
X (Easting): 652,700.0 653,510.0 10.0 82 810.0
Y (Northing): 5,535,000.0 5,535,890.0 10.0 90 890.0
Z (Elevation): 1,230.0 1,530.0 10.0 31 300.0
Scan Datasheet
Preview Dimensions
Borehole Manager
Utilities
ID Symbol Easting Northing Surface Elevs 6 7
These settings establish project boundaries.
These determine grid & solid model densities. As you change the spacing, the number of nodes will change. These are IMPORTANT.

This window is also displayed when you click the Adjust Project Dimensions link from many of the program's menus, shown below.

These settings are stored in the current project database. Though these dimensions can be overridden during model and diagram creation, we generally recommend that you utilize these dimensions for your grid models, solid models, and diagram annotations for ease and consistency. For example, all the project grid models must have the same dimensions and node densities if you wish to perform any mathematical or filtering operations with them. The same holds true for solid models.

For new projects the dimensions will default to a range of 0 to 100 along all axes.

1. The first step in setting project dimensions is by scanning the data you have entered into the RockWorks Utilities datasheet using the ***Scan Datasheet*** button:
2. Define the columns to be scanned



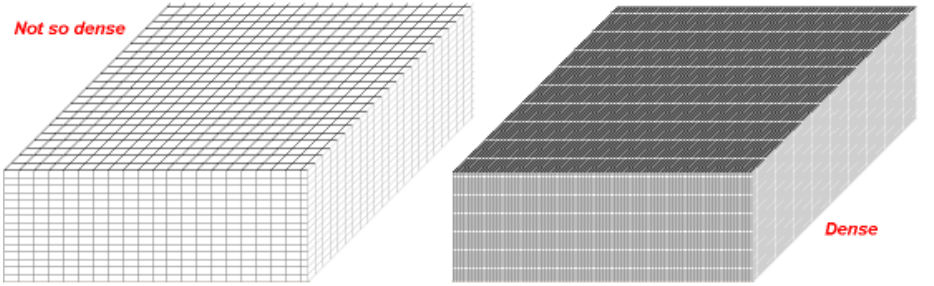
Input Columns: Click the down-arrow to select from the drop-down list the name of the column in the datasheet that contains the Easting or X-coordinate units, the Northing or Y coordinate units, and the Elevation or Z coordinate units to be scanned for the project dimensions. For any axes you don't choose to scan, below, the column setting will be ignored.

Scan for X-Data, ***Y-Data***, ***Z-Data***: Check the boxes for the columns, defined above, to be scanned. If you leave any options un-checked, that data will not be scanned for the project dimensions. If you are generating 2D maps only, you should scan for X and Y Data only. If you are generating 3D solid models, you should scan for all three axes.

! Of course, you can hand-enter the desired boundary coordinates or modify scanned coordinates at any time.

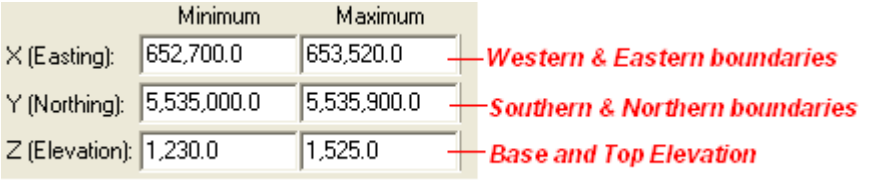
3. Review scanned settings:

   Click the Preview Dimensions button to see a quick view of how dense your models will be:

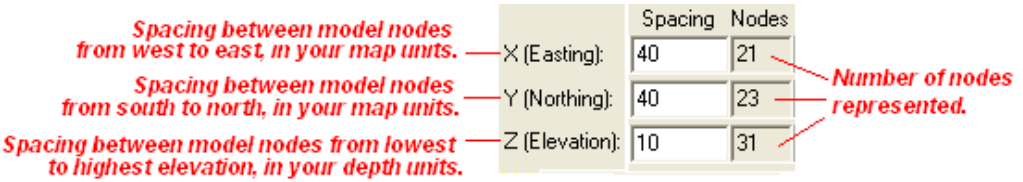


Dimensions: These boundary coordinates can be hand-entered or can be determined

by the program by clicking on of the buttons listed above. The X and Y boundaries represent your map coordinates. The Z boundaries represent elevation extents.



Spacing: These settings pertain to grid models and solid models. They represent the spacing between nodes in the X (west to east), Y (south to north), and Z (elevation) dimensions. LOOK AT THESE NUMBERS. Node density affects the quality of the model and the time necessary to generate it.



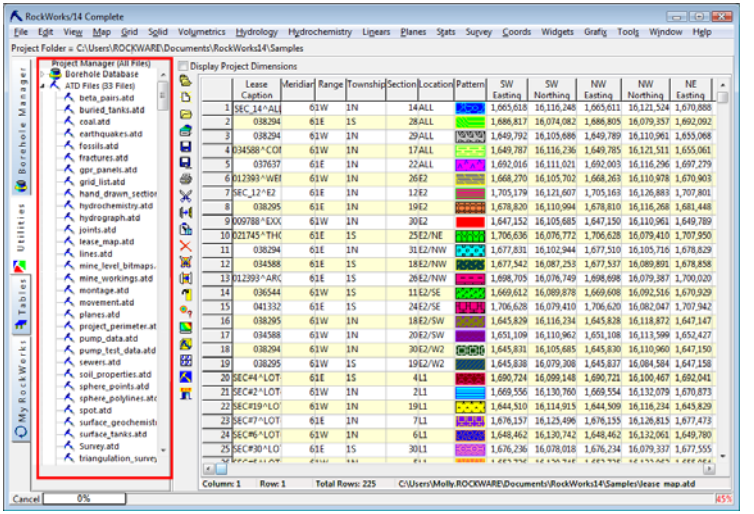
Nodes: These prompts display the number of nodes that will be generated along each axis. These are computed automatically, based on the dimensions divided by the spacing. You cannot edit the node settings; to adjust the density, edit the spacing.

Show Advanced Options: Insert a check here to display project dimension statistics and other settings. These are discussed fully in the Help messages.

Help / Contents / Setting Project Dimensions and Preferences

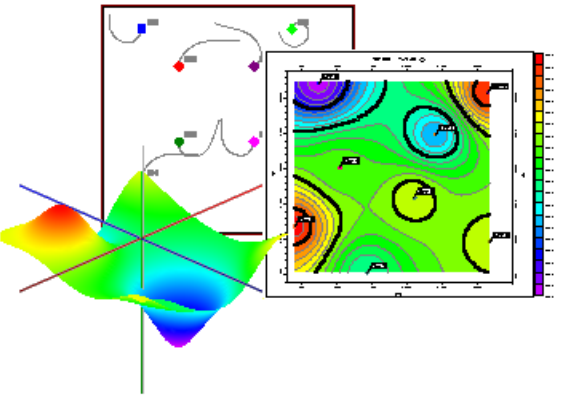
Using the Project Manager

The Project Manager is a pane that can be displayed along the left edge of the program window which displays various RockWorks program files in the current project folder.



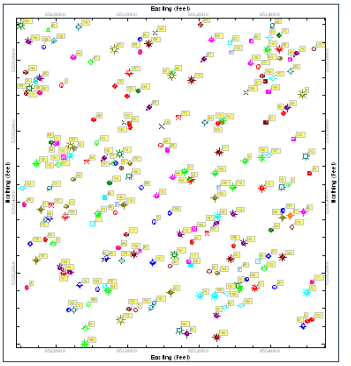
- Turn the Project Manager pane on/off using the **Tools** / **General Preferences** / **Display Project Manager** checkbox.
- Expand any file-type grouping by clicking the small "+" button by its heading; contract any grouping by clicking on the small "-" button.
- Hover over 2D Diagrams and 3D Diagrams files to view previews of the images. (The previews can be disabled in **Tools** / **General Preferences** / **Display Project Manager** / **Display Diagram Previews**.)
- Open a file (ATD files, RK6 and R3DXML diagrams, and miscellaneous tables) by double-clicking on its name in the Project Manager pane. (Or, right-click on the file name and choose the view/load/edit option.)
- Create a 2D contour map or 3D surface of a grid model by double-clicking on the GRD file name and establishing the map/diagram settings. (Or, right-click on the file name and choose Display Grid.)
- Create a 3D voxel or isosurface diagram of a solid model by double-clicking on the MOD file name and establishing the diagram settings. (Or, right-click and choose Display Solid.)
- Start an RCL script by double-clicking on the RCL file name in the Project Manager pane.

Chapter 4 – Creating Point, Contour and 3D Surface Maps, and other Maps



These are some of the most commonly used tools of the RockWorks program: Mapping **sample locations** (wells or basic surface sites), creating maps that illustrate a quantitative value (elevations, formation thickness, surface geochemistry, etc.) measured at multiple X,Y locations. These can be **2D contour maps** or **3D surface** maps. In addition, you can create maps that illustrate shotpoint locations, land grid sections or leases, global points or polylines, borehole logs, Stiff diagrams, rose diagrams.

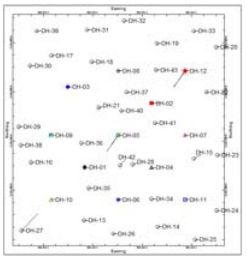
Point Maps



The procedures you will follow to create a point map will vary depending on whether you have entered your data into the Borehole Manager or into the RockWorks Utilities datasheet (where you have X andY locations, at minimum). Point maps are displayed in RockPlot2D.

! Use point maps as overlays over other 2D maps (isopachs, structural contours, etc.). Just save the borehole location map in RockPlot2D, and you can then append this map to any other 2D plan image in your project (RockPlot2D File/Append).

Borehole Manager: Map / Borehole Locations



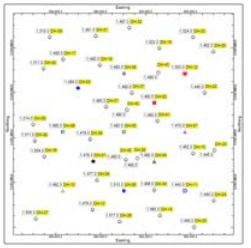
Use the Borehole Manager's **Map** / **Borehole Locations** tool to create a 2-dimensional or plan view of your borehole locations. These maps may include unique symbols and labels for each borehole, with optional borehole trace plots for deviated holes, borders, and bitmap backgrounds. You can request a grid model of the borehole surface elevations (also read from the Location tabs) for display as line or color-filled contours with your point map (see page 109).

Notes: Check your coordinates: If your borehole locations (as entered into the Location tabs) are not in Eastings and Northings, you'll need to translate your longitude/latitude or Range/Township/Section descriptions first.

Borehole Manager Tutorial: Create a Borehole Location Map.

Help / Contents / Borehole Manager / Location Maps & Coordinate Tools.

RockWorks Utilities: Map / EZ Map



The **EZ-Map** tool is used to build 2-dimensional (flat) maps for X, Y, and Z coordinate data that can include several map layers. (Contour lines and color-filled contours are optional. See also a later section regarding including contour lines.)

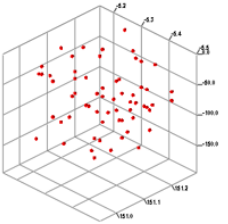
Datasheet: RockWorks Utilities "XYZ" file (page 78)

Notes: RockWorks can create maps with uniform or variable symbol styles, and with uniform or variable symbol sizes. This can be handy for differentiating your sites, and/or for illustrating different measured values at those sites. You can include single or multiple labels for each symbol. The program can automatically offset labels if overprinting is a problem.

RockWorks Utilities Tutorial: Create Point and Surface Maps.

Help / Contents / RockWorks Utilities / Mapping Tools / Contour and Point Maps / Creating Easy Maps.

RockWorks Utilities: 3D Points



The **Map** / **3D Points** tool is used to plot points in 3D space representing X, Y, Z points listed in the Utilities datasheet. It has two main sub-options titled "Simple" and "Advanced".

The "Simple" version will prompt the user for three columns within the datasheet that contain the X (Easting), Y (Northing), and Z (Elevation) for a list of points. The output from this program will be displayed as equally-sized red spheres.

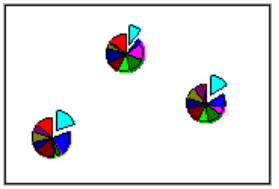
The “Advanced” program offers variable symbols, variable sizing, and other optons.

Datasheet: RockWorks Utilities “XYZ” file (page 78)

Note: This tool used to be listed in the Grafix / 3D Utilities / Spheres program.

Help / Contents / RockWorks Utilities / Mapping Tools / Contour and Point Maps.

RockWorks Utilities: Map / Multivariate Maps



The **Map** / **Multivariate Maps** tools are used to create maps that illustrate two or more components at specific X,Y locations.

Pie chart maps illustrate the relative percentage of the selected variables as varying-*width* pie "slices" at each sample location. Examples include whole-rock geochemistry, relative sand/silt/clay ratios, and non-geological parameters such as population breakdowns.

Starburst maps illustrate the relative percentage of the selected variables as varying-*length* pie "slices" at each sample location. Each component within a starburst has a scaling factor that determines the radius of the wedge. This allows you to create diagrams for variables with different units. For example, one wedge within a starburst could represent amount of silica, which another could represent fracturing, which a third might represent amount of alteration.

Bar chart maps illustrate the relative percentage of the selected variables as varying-length histogram bars at each sample location.

Spider maps illustrate the relative percentage of the selected variables as polygons within a circle, at each sample location.

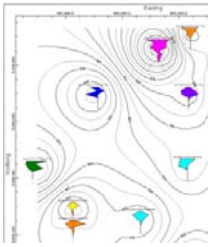
Datasheet: RockWorks Utilities “XYZ” file, with multiple Z-value columns (page 78)

Notes: Refer to the Help messages for details about how to set up the data columns and apply a scaling multplier for the starburst and bar chart maps.

RockWorks Utilities Tutorial: Analyze Component Data

Help / Contents / RockWorks Utilities / Mapping Tools / Multivariate Maps.

Stiff Diagram Maps



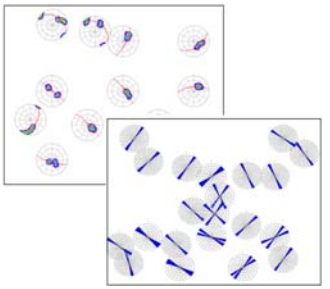
The RockWorks Utilities **Hydrochemistry** / **Stiff Maps** command is used to read a listing of ion concentrations from the datasheet, create a Stiff diagram for each sample, and plot the diagrams at each sample location in a map.

See the description of Stiff diagrams (page 185) for information about their structure.

Notes: You may choose up to 4 additional cations and up to 4 additional anions for display in the Stiff polygons.

Help / Contents / RockWorks Utilities / Hydrochemistry Tools / Creating Stiff Diagram Maps.

Rose and Stereonet Diagram Maps

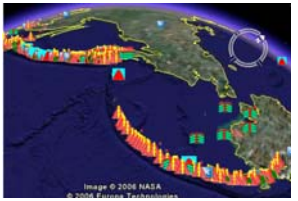


The Borehole Manager's **Fractures** menu contains tools for generating maps that illustrate fracture orientations, 2D and 3D, at each borehole location using rose diagrams and stereonet diagrams. The bearing (and dip) data is read from the Borehole Manager database's Fractures table for each borehole.

See the description of Rose diagrams (page 188) and Stereonet diagrams (page 191) for information about their structure.

Help / Contents / Borehole Manager / Fracture Tools / Creating Rose Diagram Maps, Creating Stereonet Diagram Maps.

Google Earth Maps



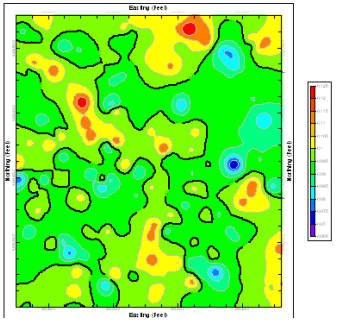
The Utilities **Map** menu contains a **Google Earth** submenu that offers plotting of

- Placemark maps,
- Polygon maps, and
- Polyline maps in Google Earth.

These tools create a Google Earth KMZ (Keyhole markup language binary) file based on the contents of point, polygon, or polyline information listed in the Utilities datasheet.

Help / Contents / RockWorks Utilities / Creating Maps.

2D Contour Maps



Contour maps illustrate quantitative values that have been measured over space. They can be used to illustrate geological topics such as surface elevations, formation thickness or average geochemical concentrations. They can illustrate non-geological topics such as average voter turnout in a city or numbers of crimes in a neighborhood.

Entire books have been written about computer contouring, and that is a subject well beyond the scope of this manual. Here we offer a summary of the tools you can use in RockWorks to generate contour maps. For more information about the concepts of gridding and contouring, please refer to the Help messages.

2D Contour maps are displayed in the RockPlot2D window.

To grid or not to grid?

RockWorks offers two methods of creating 2D contour maps: Delaunay triangulation contouring and grid-based contouring.

Delaunay Contouring

To generate contours, the Delaunay triangulation method constructs a series of triangles with a data point at each vertex. The triangles are constructed so that the angles are as close as possible to equi-angular. Contour lines are then interpolated between the triangle vertices and connected together to form the map. This process has been referred to as "dip-contouring" by some geologists.

Because it by-passes the gridding step, this mapping method operates the most quickly. In addition, it honors all of the data values; many people prefer this method of contouring since there is no loss of data integrity as a result of gridding. However, RockWorks cannot build 3D surface maps using this method. Also, non-grid triangulation can leave blank areas in the map where there are no control points, unless you tell the program to insert "edge points." Contours tend to be very angular. You must have at least four XYZ point triplets to create a Delaunay contour map using the RockWorks Utilities **Map** / **EZ Map** tool. The **Planes** / **3-Point** tool requires only 3 input triplets.

Grid-Based Contouring

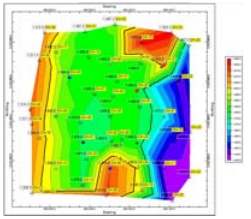
Gridding is a process in which scattered, spatially-distributed data can be transformed into a regular grid of numeric values. You might picture a grid model as a grid of imaginary lines that overlays your source data points. In the process of gridding, the program assigns a value to the grid line intersections, called grid nodes. RockWorks offers several mathematical methods to do this interpolation of your data. Each operates differently, and each has strengths and weaknesses.

A grid file is the computer file of numbers that contains the results of the gridding process. It contains a listing of the X and Y location coordinates of the regularly-spaced grid nodes and the extrapolated Z value at each node.

Because gridding is an interpolation process, it's possible for the resulting map to look quite different than you had expected. The benefits of gridding include having more control over the map process, editing and filtering tools, smoother maps, and the ability to construct 3D surfaces.

We generally recommend that you create both types of maps: Create a quick contour map using the Delaunay triangulation technique, and then create another based on a grid model. Compare them to determine which more accurately models your data. Some of the mapping tools are discussed in the following topics.

RockWorks Utilities: Map / EZ Map



The **Map** / **EZ-Map** tool is used to build 2-dimensional (flat) maps for X, Y, and Z coordinate data, using the Delaunay triangulation technique. The maps can include several map layers. (On an earlier page, we discussed creating a simple point map of X,Y data. It's the same program tool – just be sure to turn on line or color contours.)

Datasheet: RockWorks Utilities "XYZ" file (page 78)

Notes:

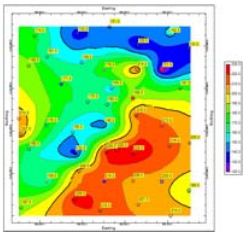
Because this contouring method draws a triangulation network among the given control points only, the Interpolate Edge Points map option can be used to force the map edges to a full rectangular shape.

Delaunay triangulation is only available in the RockWorks Utilities window. If you are working with Borehole Manager data, you can transfer locations, stratigraphy, and other data to the RockWorks Utilities window for mapping there (**File** / **Transfer**).

RockWorks Utilities Tutorial: Create Point and Surface Maps

Help / Contents / RockWorks Utilities / Mapping Tools / Contour and Point Maps / Creating Easy Maps.

RockWorks Utilities: Map /Grid-Based Map



The **Map / Grid-Based Map** tool is used to create grid models of XYZ data in the RockWorks Utilities datasheet or in an external ASCII file. The Z values can represent surface elevations or geochemistry or virtually any measured value. You can choose the "gridding" method used to model the Z values. You can then create a 2-dimensional (flat) map or 3-dimensional surface map of the grid model. This section discusses 2D maps.

! If you have borehole data and wish to create grid-based formation structure maps, isopach maps, or surface elevation maps, see the next topics.

Datasheet: RockWorks Utilities "XYZ" file (page 78). Note that this tool will also grid and map XYZ data stored in an external ASCII file

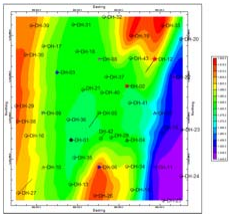
Notes: This tool can create a grid model alone (no map), a map of an existing grid model, and a new grid model and map of the XYZ data. Since the grid model is saved on disk, you can create a map from an existing grid model (no need to re-grid). This is useful if you have processes a grid model through the filtering tools in the RockWorks Utilities **Grid** menu. This tool can create 3D surface maps of grid models, as well.

! Use the Project Manager to create a quick 2D map or 3D surface illustrating a grid model: just double-click on a GRD file name and establish the map settings. (See page 101.)

RockWorks Utilities Tutorial: Create Point and Surface Maps 2D.

Help / Contents / RockWorks Utilities / Mapping Tools / Contour and Point Maps / Grid-Based Maps

Borehole Manager: Map / Borehole Locations



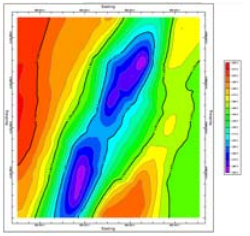
The Borehole Manager's **Map** / **Borehole Locations** tool is used to create a symbol map of the borehole locations. It can also be used to generate a grid model and a 2D contour map of the borings' surface elevations.

- Use this surface elevation grid model to clip your solid lithology, p-data, i-data, or fracture models, so as to set nodes above the ground to zero. Just specify the surface grid as the Upper Surface Filter under Model Constraints.

- To create a 3D image of the resulting surface grid model, you can use the Project Manager: double-click on the GRD file name and establish the map options. Or, use the RockWorks Utilities Map / Grid-Based Map tool, selecting Use Existing Grid and specifying the name of the grid model created here.

Help / Contents / Borehole Manager / Location Maps & Coordinate Tools.

Borehole Manager: Stratigraphy / Structural Elevations / 2D



Use the Borehole Manager's **Stratigraphy** / **Structural Elevations** / **2-Dimensional** tool to create a 2-dimensional (flat) contour map representing the elevations at the surface of a selected stratigraphic unit. You can choose the gridding method to be used to model the formation elevations. The structure map can include a variety of map layers.

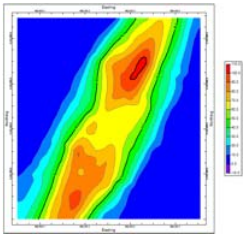
See also: Grid-based maps (page 109) for information about creating 2D contour maps from simple XYZ data in the RockWorks Utilities datasheet.

Notes:

- Be sure you have your formations listed correctly in the Stratigraphy Table.
- The grid model that's created in this program can be manipulated using the RockWorks Utilities **Grid** menu tools, and displayed using **Map** / **Grid-Based Map** (choose Use Existing Model).
- If you wish to transfer your stratigraphic data to the RockWorks Utilities datasheet, you can do so using the **File** / **Transfer** / **Stratigraphy -> Utilities Datagrid** or **Stratigraphy** / **Export** tools.

Help / Contents / Borehole Manager / Stratigraphy Tools / Structure Maps 2D & 3D.

Borehole Manager: Stratigraphy / Stratigraphic Thickness / 2D (Isopach)



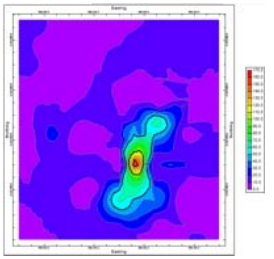
Use this tool to create a 2-dimensional (flat) contour map representing the *thickness* of a selected stratigraphic unit. The "isopach" map can include line contours, color contours, border annotation, and/or labeled cells (representing grid values).

RockWorks creates the thickness model by gridding the formation's upper surface elevations, gridding the formation's lower surface elevations, and then subtracting the lower grid from the upper. The resulting isopach grid can be saved for future use.

Notes: Be sure you have your formations listed correctly in the Stratigraphy Table. If you want the program to save on disk the grid model of formation thickness, be sure to insert a check in the ***Save Grid*** box and enter a grid file name.

Help / Contents / Borehole Manager / Stratigraphy Tools / Isopach Maps.

Borehole Manager: I-Data, P-Data, Fractures / Plan-Map



Use the Borehole Manager's **I-Data**, **P-Data**, and **Fracture** / **Plan Map** tools to create a solid model representing the downhole data (or read an existing model) and slice it horizontally at a user-specified elevation. The resulting grid model (GRD) can be displayed as a 2-dimensional map in which the data values can be color-coded in a variety of ways. These maps are discussed in Chapter 8 - Creating Solid Models, and Voxel/Isosurface, Profile, Section, Fence, Plan and Surface Diagrams

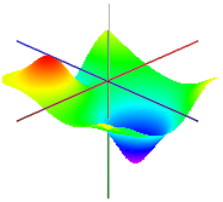
Borehole Manager: Aquifers / Plan-Map

Use the Borehole Manager's **Aquifer** / **Plan** tool to create a 2-dimensional (flat) contour map of the aquifer surface, base, or thickness for a particular date or date range. These maps are discussed in Chapter 7 - Water Levels: Display as Profiles, Sections, Plans, Fences, and Blocks

Other Contouring Tools

The RockWorks Utilities **Grid** menu offer a number of grid model filtering and manipulation tools. Most of these menu items offer the option to create a map of the resulting grid – see Chapter 10 - Grid Model Tools.

3D Surface Maps

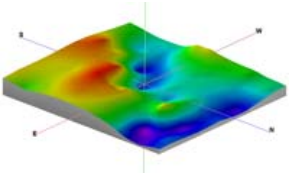


"3-dimensional" surface maps are really just a 3D view of a 2-dimensional contour map. Like the 2D maps, they illustrate quantitative values that have been measured over space. Like the 2D maps, they can be used to illustrate geological topics (surface elevations, formation thickness, average geochemical concentrations) as well as non-geological topics such as crime incidents in a precinct.

RockWorks offers both a grid-based and a non-grid based means of creating 2D maps. By contrast, 3D surface maps must be generated from a grid model. See the previous section for details.

3D surface maps are displayed in the RockPlot3D window.

RockWorks Utilities: Map / Grid-Based Map



This tool is used to create grid models of XYZ data in the RockWorks Utilities datasheet or in an external ASCII file. The Z values can represent surface elevations or geochemistry or virtually any measured value. You can choose the gridding method to be used to model the Z values. You can then create a 2-dimensional (flat) map or 3-dimensional surface map or flat projection of the grid model. This section discusses 3D maps.

! If you have borehole data and wish to create grid-based formation structure maps, see a later topic in this section.

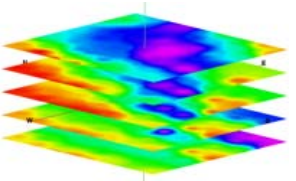
Datasheet: RockWorks Utilities "XYZ" file (page 78) Note that this tool will also grid and map XYZ data stored in an external ASCII file

Notes: This tool can create a grid model only (no surface), a surface of an existing grid model, or a new grid and surface. Since the grid model is saved on disk, you can create a surface from an existing grid model (no need to re-grid). This is useful if you have processed a grid model through the filtering tools in the RockWorks Utilities **Grid** menu, created the grid originally in the Borehole Manager, etc. This tool can create 2D surface maps of grid models, as well (discussed previously).

! Use the Project Manager to create a quick 2D map or 3D surface illustrating a grid model: just double-click on a GRD file name and establish the map settings. (See page 101.)

Help / Contents / RockWorks Utilities / Mapping Tools / Contour & Point Maps / Grid-Based Maps.

RockWorks Utilities: Grid / Grids -> 3D Stack



The RockWorks Utilities **Grid** / **Grids -> 3D Stack** program is used to plot multiple, flat grids in 3D space for the purpose of visual comparisons. These grid models can represent any real number values (geochemical concentrations, elevations, porosity values, quality readings, you name it). These are grid models that already exist on your computer.

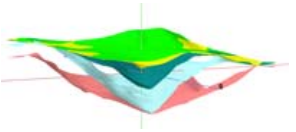
Datasheet: RockWorks Utilities. It reads a file containing a single column of grid (.GRD) file names, listed from the top down in the same order in which they are to be stacked, top-down, in the diagram.

Notes: Be sure the grid models actually exist in the current project folder. Once displayed in RockPlot3D, you can turn individual surfaces on and off by inserting/removing the check-marks by the grid model names in the RockPlot3D data tree (you may need to expand the "Stack" heading). If you expand the grid model groups in the data tree, and

double-click on any of the Flat Grid entities, you can adjust the color scheme, drawing style, and other visual characteristics.

Help / Contents / RockWorks Utilities / Grid Model Tools / Stacked Surface Tools.

Borehole Manager: Statigraphy / Structural Elevations / 3D

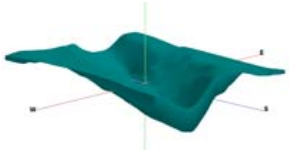


Use this tool to create 3-dimensional images representing the surface elevations of one or all stratigraphic unit(s) in the project.

Notes: If you create surfaces for all formations, the program will automatically name the grid models using the formation name with the "*.grd" file name extension. Be sure you have your formations listed correctly in the current Stratigraphy Types Table.

Help / Contents / Borehole Manager / Stratigraphy Tools / Structure Maps 2D & 3D.

Borehole Manager: Stratigraphy / Stratigraphic Thickness / 3D



Use this tool to create a 3-dimensional image which represents the thickness of a selected stratigraphic unit. The completed image will be comprised of a surface representing the formation's top, a surface representing the formation's base, and enclosing sides.

Notes: In RockPlot3D the program will display the computed volume and mass of the selected formation. In order for these computations to be accurate, be sure that your depth units are the same as your X,Y units (such as feet) so that the cubic volume (as in ft^3) makes sense. In addition, the mass computation is based on the density per cubic unit as declared in your Stratigraphy Types Table.

Help / Contents / Borehole Manager / Stratigraphy Tools / Isopach Maps 2D & 3D.

Other 3D Surface Tools

The RockWorks Utilities **Grid** menu offer a number of grid model filtering and manipulation tools. Most of these menu items offer the option to create a 3D surface display of the resulting grid – see Chapter 10 - Grid Model Tools.

Log Maps

The Borehole Manager **Striplogs** / **Multi-Log Plan View** option is used to create a plan-view display of deviated wells, as projected onto a horizontal plane. The **Striplogs** / **Multi-Log Map** tool creates a borehole location map with mini-striplogs at the sample locations. These items are discussed in Chapter 5, see page 122.

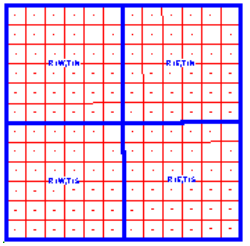
Land Grid Maps

The RockWorks Utilities **Map** / **Land Grid** menu contains two tools designed to work with Jeffersonian Land Grid information:

* It creates "section maps" that illustrate Range, Township, and Section lines (either commercial or idealized, or based on the RockWare Landbase).
* It creates maps illustrating lease boundaries.

In order to create a land grid section or lease map, you must have a set of land grid data imported or “interpolated” into the program, or have downloaded the RockWare Landbase containing data for the area of interest.

RockWorks Utilities: Map / Land Grid / Section Map



Section maps illustrate Jeffersonian land grid boundaries (Range, Township, Section).

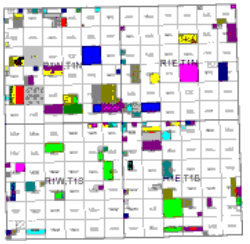
Datasheet: Land Grid Table (page 266) or the RockWare Landbase.

Output window: RockPlot2D

! In order to create a land grid section map, you must have already created a "Land Grid Table" which lists the longitude and latitude coordinates of each section’s corners. Or, you can download the RockWare Landbase (see Help / Download / RockWare Landbase).

Help / Contents / RockWorks Utilities / Creating Maps / Land Grid Maps.

RockWorks Utilities: Map / Land Grid / Lease Map



This tool creates a map illustrating lease block boundaries, filled with patterns and/or colors.

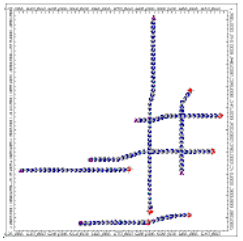
Datasheet: RockWorks Utilities land grid lease descriptions (page 80).

Output window: RockPlot2D

Notes: The input data file should include lease corner coordinates and patterns. Use the **Coords** / **Spot Jeffersonian Polygons** tool if your lease blocks are listed only in Range, Township, and Section descriptions. (You need to have X, Y corner coordinates.)

Help / Contents / RockWorks Utilities / Creating Maps / Land Grid Maps.

Shotpoint Maps



The RockWorks Utilities **Map** / **Shotpoints** command is used to create a map that illustrates shotpoint locations as read from the datasheet.

The shotpoint data must include (at minimum) a shotpoint line number, a symbol, and an X and Y coordinate for the individual shotpoint. You may optionally include the point number (not used in the map) and a label for points, typically representing distance. Each seismic line will have two or more data rows containing individual point records.

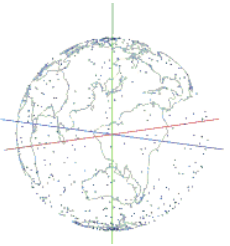
Datasheet: RockWorks Utilities shotpoint data (page 81).

Output window: RockPlot2D

Notes: See also Importing SEG-P1 Data (page 97) re: import of SEG-P1 shotpoint files.

Help / Contents / RockWorks Utilities / Mapping Tools / Shotpoint Maps.

Global Maps



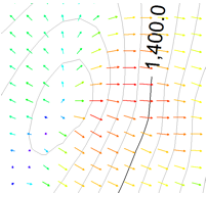
The RockWorks Utilities **Map** / **Sphereplot 2D** and **3D** options create global maps in either a spherical or cylindrical (flat) projection, or in 3D format. 2D maps can contain low-resolution global information (coastlines, islands, rivers) from a program database. It can also read user-entered longitude and latitude coordinates from the main datasheet for plotting of individual points and/or connected line segments ("polylines") on the global map. Applications include seismic events, volcanoes, ocean temperatures, atmospheric temperatures, and more.

Datasheet: RockWorks Utilities, global map point and/or polyline data (page 81).

Output window: RockPlot2D and RockPlot3D

Help / Contents / RockWorks Utilities / Mapping Tools / Global Maps.

Directional Maps



The RockWorks Utilities **Grid** / **Directional Analysis** / **Directional Maps** option is used to illustrate slope and aspect grid models as a variety of 2-dimensional gradient and flow maps. See page 168 for more information.

Borehole Manager: Translating Map Coordinates

The Borehole Manager requires that the well locations, which are entered into the Location tab, be declared in the same units as the depth data. This assures that the downhole surveys, stratigraphic volumes, and solid (lithology, geochemistry, etc.) volumes are correctly computed. Use the Borehole Manager's **Map** / **Adjust Coordinates** tools to translate longitude and latitude or land grid (range/township/section) well locations into Eastings or Northings.

Help/Contents/Borehole Manager/Location Maps & Coordinate Tools//Converting Borehole Coordinates / From Jeffersonian (RTS) to UTM and From Longitude/Latitude to UTM.

RockWorks Utilities: Translating Jeffersonian Locations to X,Y

The RockWorks Utilities **Coords** / **Jeffersonian Points->Cartesian** option is used to translate well locations listed in Range, Township, Section descriptions (footage or quarter/quarter) to Cartesian X,Y coordinates. This translation is based on either a “Land Grid Table” of “idealized" or commercially-purchased data, or the RockWare Landbase data which covers portions of the U.S.

This tool was previously located in the **Map** / **Land Grid** menu.

See page 266 for information about Land Grid Tables.

See Help / Contents / RockWorks Utilities / Coordinate Conversion Tools / Translating Range Township Section Locations to X,Y.

RockWorks Utilities: Translating Jeffersonian Polygons to X,Y

The RockWorks Utilities **Coords** / **Jeffersonian Polygons->Cartesian** option is used to generate X,Y coordinates for each corner of leases that are listed with Range, Township, Section descriptions (quarter/quarter or lots). This translation is based on either a “Land Grid Table” of “idealized" or commercially-purchased data, or the RockWare Landbase data which covers portions of the U.S.

This tool was previously located in the **Map** / **Land Grid** menu.

See page 266 for information about Land Grid Tables.

See Help / Contents / RockWorks Utilities / Coordinate Conversion Tools / Translating Range Township Section Polygons to X,Y.

RockWorks Utilities: Translating Map Coordinates

The RockWorks Utilities **Coords** menu contains a number of utilities that can be used to translate coordinates that are listed in the RockWorks Utilities datasheet.

See Help / Contents / RockWorks Utilities / Coordinate Conversion Tools.

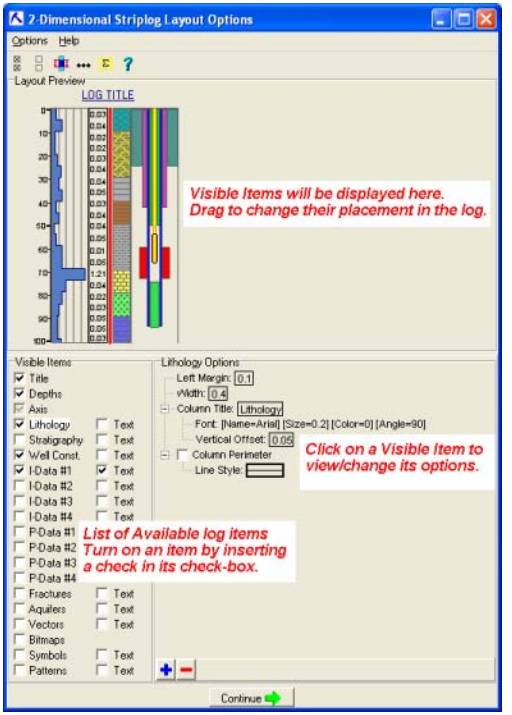
Chapter 5 - Creating Strip Logs & Log Sections

Creating Strip Logs & Log Sections - Overview

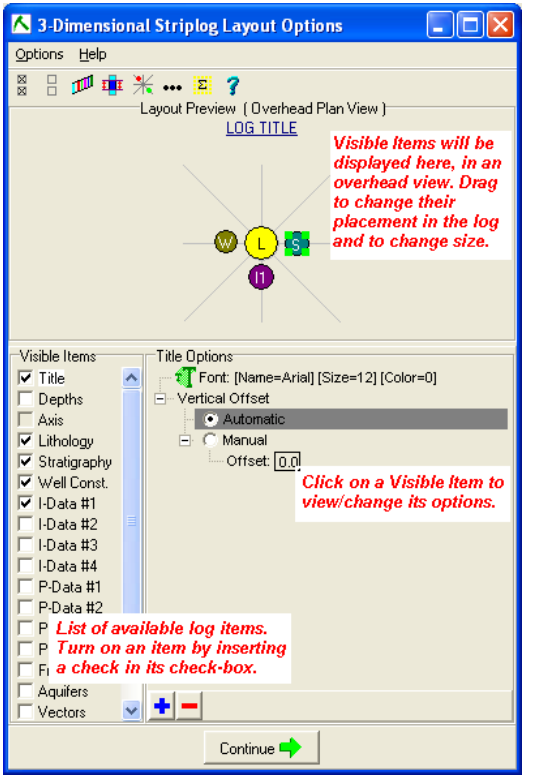
There are a variety of tools available in the Borehole Manager's **Striplogs** menu for creating 2-dimensional (flat) or 3-dimensional logs of individual or multiple borings. The log data is taken directly from the Borehole Manager data tabs.

The log options are pretty much the same for these different log views. You may choose to include any combination of the following in the logs: Well name, depth labels, lithology patterns and/or labels, stratigraphy patterns and/or labels, well construction patterns and/or labels, 1-4 curves (for downhole point data), 1-4 bar graphs (for downhole interval data) and/or labels, aquifer intervals, special symbols, special pattern blocks, fracture discs (3D), fracture or vector tadpoles (2D), vector arrows (3D), raster images, and border annotation.

Defining the arrangement of the columns in the logs is done within the 2D and 3D log designer windows. Activated (checked) log components are shown in the design pane where you can click and drag to change their position in the log.



2D log designer



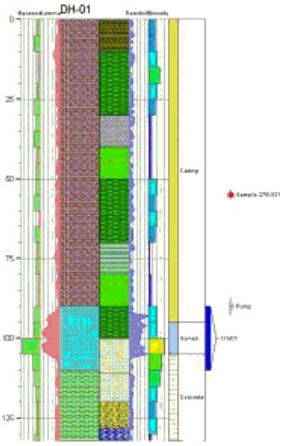
3D log designer

See also: Profiles and Sections in Chapters 6, 7, and 8 for information about creating vertical slice views (“profiles”) of interpolated stratigraphic or solid models.

See also: Log Options on page 293.

Creating 2D Logs, Log Profiles, and Projected Log Sections

Creating a Single 2D Strip Log



Use the Borehole Manager's **Striplogs** / **Single Log (2D)** tool to create a vertical, 2-dimensional (flat) strip log of a single well. The log can include any combination of the available log items listed on page 124. The log data is read from the database. The boring can be vertical, inclined, or deviated.

Menu command: **Striplogs** / **Single Log (2D)**

Output window: RockPlot2D

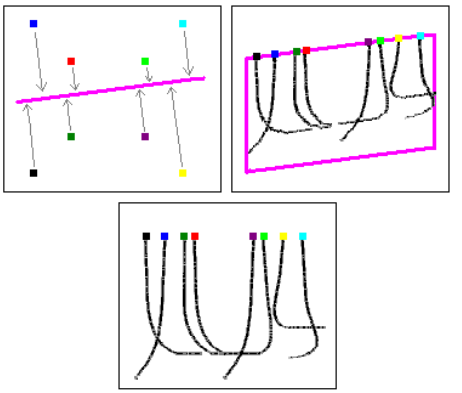
Notes: Before selecting the menu command, be sure to click on the name of the borehole whose data is to be displayed in the log, so that its name is highlighted. Be sure also that the check-box to the left of the borehole name is checked so that the borehole is enabled.

Borehole Manager Tutorial.

Help / Contents / Borehole Manager / Logs and Cross Sections / Creating a Single 2D Striplog.

What is a Log Profile?

A log profile is one in which the logs of individual borings are "projected" onto a single profile line cut.

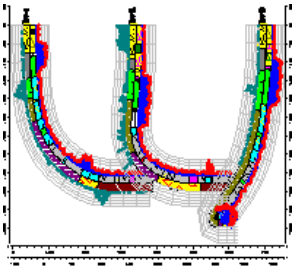


These diagrams can display vertical, inclined, and deviated boreholes. By projecting onto a line of section, the orientation of the logs will be honored.

In log profiles, the distance between logs is determined by their perpendicular projection onto the profile line. (This differs from hole-to-hole sections, in which the distance between the logs is proportional to the well distances on the ground.) In RockWorks, drawing the profile line is easily done on a plan-view display of the well locations, or you can enter known coordinates for the section endpoints. In addition, you can enter a filtering distance to limit the cross section to only proximal wells.

Help / Contents / Laying Out Vertical Sections and Fences.

Displaying Multiple Logs in a 2D Log Profile



Use the Borehole Manager's **Striplogs** / **Multi-Log Profile** tool to create a projected 2-dimensional vertical display of strip logs of multiple boreholes. The logs can include any combination of the available log items listed on page 124. The log data is read from the database. The borings can be vertical, inclined, There is an option to create multiple, parallel profiles automatically.

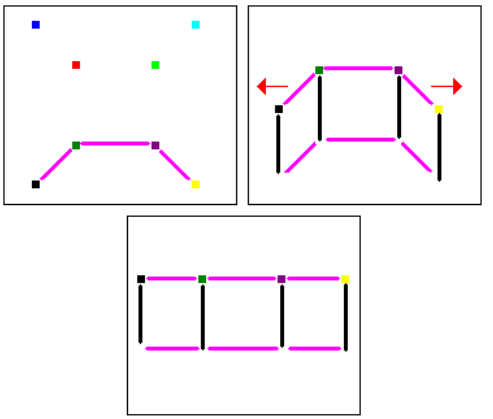
Menu command: **Striplogs** / **Multi-Log Profile**

Output window: RockPlot2D

Notes: When drawing the profile line among the boreholes, the program offers a "clipping" zone beyond which distant logs will not be projected onto the profile. See page 157 for information about drawing the profile slices.

Help / Contents / Borehole Manager / Logs and Cross Sections / Displaying Multiple Logs in a 2D Profile.

What is a Hole to Hole Cross Section?



A hole to hole cross section is created by selecting individual boreholes, in any order, that are to be displayed from left to right in the section.

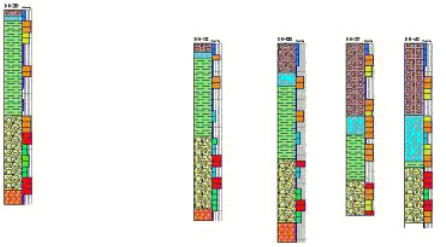
Hole to hole sections can include strip logs (with any/all available log items displayed). The logs can be hung on any listed stratigraphic interval.

In hole to hole sections, the distance between logs is proportional to the physical distances between the boreholes on the ground. (This differs from log profiles, in which the distance between logs is determined by their perpendicular projection onto a single profile line.) Because the hole

to hole trace can contain multiple segments that differ in direction, it's impossible to project a 3-dimensional log, so all boreholes are plotted as vertical.

In RockWorks, drawing the hole to hole section lines is easily done on a plan-view display of the borehole locations. The program will remember the traces from one session to the next within the current project.

Displaying Multiple Logs in a 2D Hole to Hole Section



Use the Borehole Manager's **Striplogs / Multi-Log Section** tool to create a 2-dimensional vertical display of strip logs of multiple boreholes. The logs can include any combination of the available log items listed on page 124, whose data is read from the data tabs. Multi-log sections also offer the ability to hang the section from a selected stratigraphic unit.

Menu command: **Striplogs** / **Multi-Log Section**

Output window: RockPlot2D

Notes: Unlike log profiles, logs in hole-to-hole sections must be plotted as vertical.

In a hole-to-hole cross section, the order in which the drill holes are selected will make a big difference in the appearance of the diagram. The first hole you select, regardless of its position in the map, will be at the left edge of the cross section, and the last will be at the right edge. The intermediate drill holes will be spaced in the diagram relative to each other in space. You do not need to include all boreholes in the cross section.

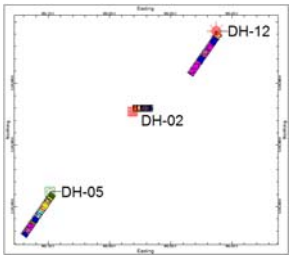
See page 159 for information about drawing the section trace.

Borehole Manager Tutorial

Help / Contents / Borehole Manager / Logs and Cross Sections Sections / Displaying Multiple Logs in a 2D Hole to Hole Section.

Creating Log Maps

Creating a Multi-Log Plan View Map



Use the Borehole Manager's **Striplogs** / **Multi-Log Plan-View** tool to create a projected plan view display of all active boreholes. This is designed to display the true displacement of deviated or inclined drill holes, as projected onto a horizontal plane.

The log can include any combination of the available log items listed on page 124. The log data is read from the database.

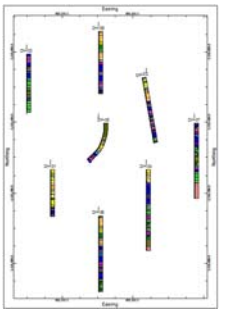
Notes:

It is not advisable to include the Depth labels in the logs since they will not project well into the plan-view plane. They can also slow the generation of the image.

This tool can be slow – be sure to turn off all non-essential boreholes and/or use the Omit Vertical Boreholes setting to avoid lengthy processing.

Help / Contents / Borehole Manager / Logs and Cross Sections / Creating Multi-Log Plan View Maps.

Creating a Multi-Log Map



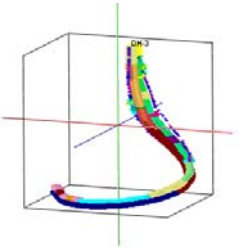
Use the Borehole Manager's **Striplogs** / **Multi-Log Map** tool to create a map that shows your borehole locations, with a small view of each log next to the map symbol. Unlike the projected view mentioned above, this tool simply creates a mini version of each log.

The log can include any combination of the available log items listed on page 124. The log data is read from the database.

Help / Contents / Borehole Manager / Logs and Cross Sections / Creating Multi-Log Maps.

Creating 3D Logs

Creating a Single 3D Strip Log



Use the Borehole Manager's **Striplogs** / **Single Log 3-D** tool to create a three-dimensional view of the strip log of a single well. The log can include any combination of the available log items listed on page 124. The log data is read from the database.

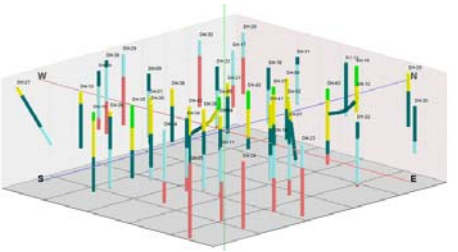
Menu command: **Striplogs** / **Single Log 3-D**

Output window: RockPlot3D

Notes: Before selecting the menu command, be sure to click on the name of the borehole whose data is to be displayed in the log, so that its name is highlighted. Be sure also that the check-box to the left of the borehole name is checked so that the borehole is enabled.

Help / Contents / Borehole Manager / Logs and Cross Sections / Creating Single 3D Strip Logs.

Displaying Multiple Logs in 3D



Use the Borehole Manager's **Striplogs** / **Multi-Log 3-D** tool to create a three-dimensional view of the strip logs of two or more wells. The logs can include any combination of the available log items listed on page 124. The log data is read from the database.

Menu command: **Striplogs** / **Multi-Log 3-D**

Output window: RockPlot3D

Notes: Before selecting the menu command, be sure to click on the name of the borehole whose data is to be displayed in the log, so that its name is highlighted. Be sure also that the check-box to the left of the borehole name is checked so that the borehole is enabled.

Borehole Manager Tutorial

Help / Contents / Borehole Manager / Logs and Cross Sections / Displaying Multiple Logs in 3D.

Log Item Summary

The following items are available for display in strip logs, displayed individually or in groups, in 2D or in 3D. Note that not all components are available for all log views.

Title: Plots the boring's name at the top of the log, read from the Location tab. Font settings adjust the text orientation, thickness, etc. 2D and 3D.

Axis: Plots the log's trace down the hole. This is always activated and is the location above which the title is plotted. You can adjust the line style, thickness, and color. Handy also for simply showing well locations in sections and 3D views. 2D and 3D.

Depth Labels: Plots depth labels down the left side of the log. Settings include labeling interval, font style, etc. 2D and 3D.

Curve 1-4: Plots a point to point curve, with or without fill, representing data read from columns in the P-Data table. The Curves have a variety of settings, and in 3D you have the option of plotting discs. 2D and 3D.

Bargraph 1-4: Plots a bargraph representing data read from columns in the I-data table. The bargraphs have a variety of settings. 2D and 3D (the latter offers additional display types).

Bargraph Text: Plots the actual numeric values for bargraphs 1-4, above. 2D only.

Stratigraphy Column: Plots a column containing intervals of pattern and color that correspond to formation names listed in the Stratigraphy data table. The pattern <-> stratigraphy name association is made in the Stratigraphy Types Table. 2D and 3D.

Stratigraphy Text: Plots stratigraphy depths, thickness, and/or keywords in 2D logs.

Lithology Column: Plots a column containing intervals of pattern and color that correspond to observed rock types listed in the Lithology data table. The pattern - rock type association is made in the Lithology Types Table. 2D and 3D.

Lithology Text: Plots lithology depths, keywords, thicknesses, and/or comments in 2D logs.

Well Construction Column: Plots a column containing intervals of pattern and color that correspond to material types rock types listed in the Well Construction data table. The pattern – material name association is made in the Well Construction Types Table. 2D and 3D.

Well Construction Text: Plots well construction depths, thicknesses, and/or comments in 2D logs.

Aquifers: Plots one or more interval blocks (representing depth to surface and base declared in the Water levels table) in 2D and 3D logs.

Aquifer Text: Plots date labels in 2D logs.

Fractures: Represented with a tadpole column in 2D logs and oriented disks in 3D logs to show fracture depth, orientation and dip.

Fractures Text: Plots fracture measurement values in 2D logs.

Special Symbols: Plots user-selected symbols at specific depths in the log, as read from the Symbols table. 2D and 3D. ***Symbols Text:*** Plots any Symbol captions in 2D logs.

Special Patterns: Plots user-selected pattern blocks between specific depths in the log, as read from the Patterns table. 2D and 3D.

Patterns Text: Plots any Pattern captions in 2D logs.

Bitmaps: Plots raster images of a variety of formats between specified depth intervals. Typically used to show raster logs or downhole photos. 2D and 3D.

Vectors: Represented with a tadpole column in 2D logs and with arrows in 3D logs to show the direction and bearing declared in the Vectors table. 2D and 3D.

Fractures Text: Plots vector measurement values in 2D logs.

Other Options: This grouping contains settings that control downhole resolution for deviated boreholes.

Clip Logs: This tool allows you to specify an elevation range for display in the single or multiple log diagrams. 2D and 3D.

Hang Section: Allows the user to align a selected stratigraphic on a horizontal line in profiles and sections.

Plot Surface Profile: Displays in profiles and sections a line representing the ground surface, read from a user-specified grid file.

Perimeter Annotation: Profiles and sections can be annotated with elevation labels, X,Y or distance labels, panel coordinates, titles, and other text.

Create Separate Location Map: The program will create a separate map illustrating the trace of the profile or cross section.

Lithology Legend: This legend displays rock types and colors as read from the project's Lithology Types Table. Settings include location, size, and offset. 2D and 3D.

Stratigraphy Legend: This legend displays formation names and colors as read from the project's Stratigraphy Types Table. Settings include location, size, and offset. 2D and 3D.

Well Construction Legend: This legend displays well construction material names and colors as read from the project's Well Construction Types Table.

Reference cage: (3-dimensional log displays only) The reference frame labels elevations, and X and Y coordinates.

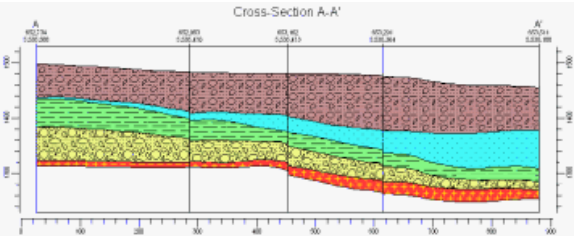
? Help / Contents / Reference / 2D Striplog Options, 3D Striplog Options.

See also 2D Striplog Options (page 293) and 3D Striplog Options (page 298) for more details.

Notes

Chapter 6 - Creating Stratigraphy Profiles, Sections, Maps, Fences, and Blocks

Creating Stratigraphic Diagrams - Overview



Use the tools in the Borehole Manager **Stratigraphy** menu to visualize your stratigraphic data (listed in the project's Stratigraphy tabs) in a variety of ways: Create 2D maps and 3D images of stratigraphic surfaces and thickness, 2D stratigraphic profiles and sections sliced anywhere in the project area, "surface" maps of stratigraphy where it intersects a surface, plan maps or horizontal slices of stratigraphy at specific elevations, 3D stratigraphic fence diagrams, and 3D stratigraphic block diagrams.

We have already covered the surface and thickness maps back on page 110. In this section, we will discuss the remaining **Stratigraphy** menu tools.

If you don't have stratigraphic layers entered into your project's Stratigraphy tabs, you can use the Pick Formations tool (page 134) to record stratigraphic depths from elogs, raster logs or lithology logs.

Unlike lithology data, which represents observed rock types which can repeat in a borehole and be inconsistent in order, stratigraphic data represents organized formations, consistent in order between boreholes, and non-repeating. RockWorks uses surface modeling or gridding tools to illustrate the stratigraphic layers. Because surface models are created for these diagrams, you must have stratigraphic data for at least 4 boreholes.

"Straight" sections and fences are also offered, in which straight line correlations are drawn between adjacent boreholes and no surface interpolation occurs.

Notes:

Formation names and the colors and patterns to be used to represent them are listed in the project's Stratigraphy Types Table (see page 255).

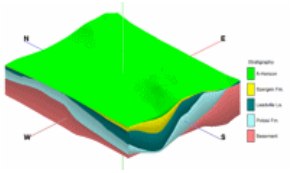
See Missing Formations (page 61) for tips on how to enter your stratigraphy data.

The program will create grid models of the surfaces and bases of the formations listed in the Stratigraphy tabs, storing the models on disk. The grid files will be assigned names in the background based on the formation: "*formation*_top.grd" and

"*formation*_base.grd". Two grid models will be created for each formation.

! Un-check the ***Interpolate Surfaces*** check-box if the grid models already exist in the project folder and don't need to be interpolated again. This can be a handy way to include GRD files that are the result of editing/filtering/other operations (page 165).

Creating a Stratigraphic Model



Use the Borehole Manager's **Stratigraphy** / **Model** tool to create a 3-dimensional surface diagram that illustrates stratigraphic layers. The stratigraphy layers will be color-coded based on the formation's background color in the Stratigraphy Types Table.

This process involves the interpolation of a grid model for the upper and lower surface of each of the stratigraphic units using the user-selected gridding method. These grid models will be stored in the project folder.

The completed diagram will be displayed in a RockPlot3D window, with formation upper surfaces, lower surfaces, and side panels. Volume and mass of each formation will be displayed in the RockPlot3D window.

The program offers optional creation of a 3D ***solid*** model representing the stratigraphy grid models layered from the bottom up, for use with other analysis tools.

Notes:

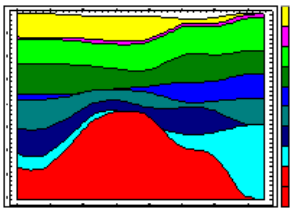
! Insert a check in the ***Save Model*** option if you want the program to store on disk a numeric 3-dimensional *solid* model, with voxel nodes representing stratigraphy type. Use a ".mod" file name extension.

RockWorks will not use this MOD file when displaying the stratigraphic surfaces in RockPlot3D at this time; it will instead display the grid surfaces. But, you may still want to store the model on disk for later filtering, volumetric computations, etc., and later 3D display with the RockWorks Utilities **Solid** menu tools.

If you have requested a stratigraphic solid model, it will be initialized using the current project dimensions. RockWorks will then "insert" each formation's surface into the solid model, by assigning the voxel the integer "G" value listed in the Stratigraphy Types Table. The program will store this stratigraphic solid model file on disk using the file name you requested. You can use this for volume computation (page 135).

Help / Contents / Borehole Manager/ Stratigraphy Tools / Creating 3D Stratigraphic Models and Diagrams.

Creating Stratigraphic Profiles



Use the Borehole Manager's **Stratigraphy** / **Profile** tool to create a 2-dimensional (flat) vertical profile of a multiple stratigraphic layers read from the Stratigraphy data tabs, between any two points in the study area. The profile layers can be color- or pattern-filled. During the process of building the profile, the program will create a grid model for each of the active stratigraphic layers using the user-selected gridding method; if preferred grid models already exist. Striplogs can be appended, and a map of the profile location can be created automatically. There is an option to create multiple, parallel profiles automatically.

Notes:

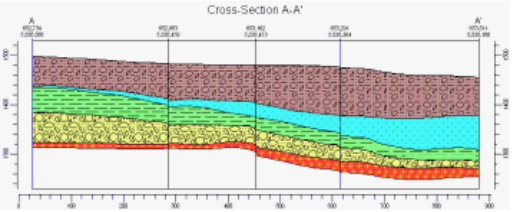
! Un-check the Interpolate Surfaces check-box if the grid models already exist in the project folder and don't need to be interpolated again. This can be a handy way to include GRD files that are the result of editing/filtering/other operations (page 165) .

See page 157 for information about drawing the profile slice.

Help / Contents / Borehole Manager/ Stratigraphy Tools / Profiles & Sections / Creating Stratigraphy Profile Diagrams.

Creating Stratigraphic Cross Sections

Modeled Sections (Grid-Based)



Use the Borehole Manager's **Stratigraphy** / **Section** / **Modeled** tool to create a 2-dimensional (flat) vertical multi-panel profile of a multiple stratigraphic layers read from the Stratigraphy data tabs, between multiple points in the study area. The panel endpoints can be anywhere within the project area – they don't need to coincide with borehole locations. The section's layers can be color- or pattern-filled, and striplogs can be appended. During the process of building the section, the program will create a grid model for each of the active stratigraphic layers using the user-selected gridding method. See the next topic for creating "straight" sections using no interpolation. Logs can be appended, and a map representing the section location can be created automatically.

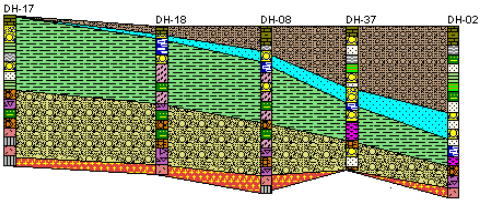
Notes:

! Un-check the Interpolate Surfaces check-box if the grid models already exist in the project folder and don't need to be interpolated again. This can be a handy way to include GRD files that are the result of editing/filtering/other operations (page 165) .

See page 159 for information about drawing the section slice. For display of multi-paneled grid-based sections in 3D, see Modeled Fences on page 130.

Help / Contents / Borehole Manager/ Stratigraphy Tools / Profiles, Sections and Fences / Creating Interpolated Stratigraphy Sections (Multi-Panel).

"Straight" Sections (No Interpolation)



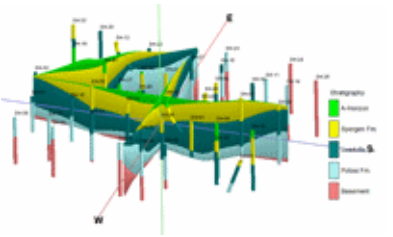
Use the Borehole Manager's **Stratigraphy** / **Section** / **Straight** tool to create a 2-dimensional (flat) vertical multi-panel profile of a multiple stratigraphic layers read from the Stratigraphy data tabs, between multiple points in the study area. The panel endpoints must coincide with borehole locations. The section's layers can be color- or pattern-filled, and striplogs can be appended. Unlike the Modeled section, the Straight section correlations will simply be drawn as straight lines between like formations in adjacent boreholes. See the previous topic for creating "modeled" sections based on grid surfaces. Sections can be hung on a specified stratigraphic unit; see below. A map illustrating the section location can be requested.

Notes: See page 159 for information about drawing the section slice. For display of multi-paneled straight sections in 3D, see Straight Fences on page 131

Help / Contents / Borehole Manager/ Stratigraphy Tools / Profiles, Sections, and Fences / Creating Interpolated Stratigraphy Sections (Multi-Panel).

Creating Stratigraphic Fence Diagrams

Modeled Fences



Use the Borehole Manager's **Stratigraphy** / **Fence** / **Modeled** and **Fence (ESRI-Format)** / **Modeled** tools to create a 3-dimensional fence diagram that illustrates stratigraphic layers, for output to RockPlot3D or to an ESRI Shapefile format.

Fence panel spacing can be regular (in a variety of configurations), or you can draw your own panels. The stratigraphy will be color-coded based on the formation's *background* color in the Stratigraphy Types Table. During the process of building the fence panels, the program will create a grid model for the upper and lower surface of each of the active stratigraphic layers using the user-selected gridding method.

3D striplogs can be appended, and a map illustrating the fence panel locations can be requested.

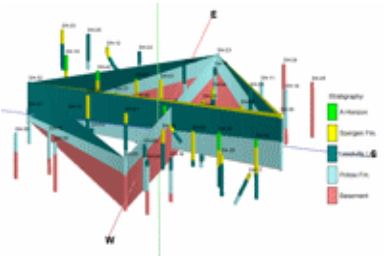
Notes:

! Un-check the Interpolate Surfaces check-box if the grid models already exist in the project folder and don't need to be interpolated again. This can be a handy way to include GRD files that are the result of editing/filtering/other operations (page 165) .

See page 161 for information about drawing the fence panels.

Help / Contents / Borehole Manager/ Stratigraphy Tools / Profiles, Sections, and Fences / Creating Interpolated Stratigraphic Fence Diagrams.

Straight Fences



Use the Borehole Manager's **Stratigraphy** / **Fence** / **Straight** and **Fence (ESRI-Format)** / **Straight** tools to create a 3-dimensional fence diagram that illustrates stratigraphic layers, for output to RockPlot3D or to an ESRI Shapefile format. Unlike Modeled fences, above, the Straight fence correlations will simply be drawn as straight lines between like formations in adjacent boreholes.

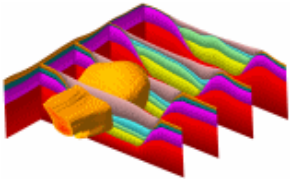
Fence panel spacing can be regular (in a variety of configurations), or you can draw your own panels. For these hole-to-hole fences, the panels will be snapped to the closest borehole. The stratigraphy will be color-coded based on the formation's *background* color in the Stratigraphy Types Table.

3D striplogs can be appended, and a map illustrating the panel locations can be requested.

Notes: See Missing Formations (page 61) for tips on how to enter your stratigraphy data. See page 161 for information about drawing the fence panels.

Help / Contents / Borehole Manager/ Stratigraphy Tools / Fence Diagrams / Creating Hole to Hole Fence Diagrams.

Manually Building 3D Stratigraphic Fences



Use the RockWorks Utilities **Grid** / **Grids -> Stratigraphic Fence** tool is used to create a stratigraphic fence diagram based on a list of existing grid models that represent the top ("superface") and base ("subface") of each unit. These are grid models that must already exist on your computer. You may request regular fence panel spacing, in a variety of configurations, or you can draw your own panels.

This program is designed for two types of applications:

Users who have created their grid models within other applications (e.g. ModFlow, Surfer) and wish to use RockWorks to create stratigraphic (or hydrostratigraphic) fence diagrams.

Users who have created their grid models within the Borehole Manager portion of RockWorks but need more flexibility in dealing with stratigraphic relationships (e.g. special manipulations with the grids).

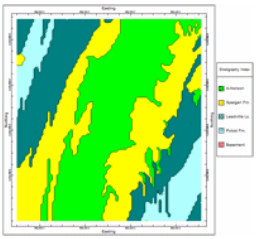
This is a “manual” way of creating the kind of stratigraphic fence that’s available in the Borehole Manager’s **Stratigraphy** / **Fence** tool.

Datasheet: RockWorks Utilities. This tool reads a “stratigraphy gridlist” data file (page 82).

Notes: Be sure the grid models that are listed in the datasheet actually exist in the current project folder. Use the “cutoff” setting to erode thin layers. See page 161 for information about drawing the fence panels. The example shown above has been combined with a 3D plume isosurface.

Help / Contents / Borehole Manager/ Grid Model Tools / Stratigraphic Tools / Manually Building 3D Stratigraphic Fences.

Creating Stratigraphy-Based Geology Maps



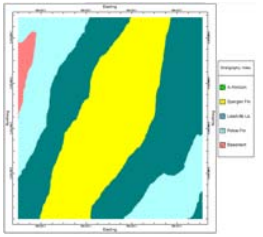
Use the **Stratigraphy** / **Surface Map** tool to create a 2-dimensional map representing the stratigraphy where it intersects a designated surface, typically the surface topography. In other words, it creates a geological map based on downhole stratigraphic data. The process involves creating a stratigraphic model for the study area, storing it as a temporary solid model (MOD), and determining the intersection of the different formations with a user-specified surface model. This is stored as a RockWorks grid model (GRD), and the map is displayed in the RockPlot2D window.

Notes: Be sure the stratigraphic names are correctly defined in the current Stratigraphy Types Table (page255). You need to be sure, also, that the dimensions and node density

of the grid model and the solid model are the same. See Missing Formations (page 61) for tips on how to enter your stratigraphy data. Use the RockPlot2D **Export** / **RockPlot3D** tool to drape the surface stratigraphy map over a grid model and display it in 3D (as in the image above).

Help / Contents / Borehole Manager/ Stratigraphy Tools / Creating Stratigraphy-Based Geology Maps.

Creating Plan-View Stratigraphy Maps

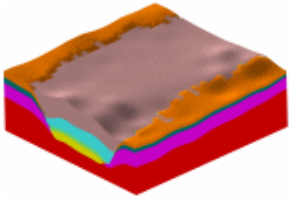


Use the **Stratigraphy** / **Plan Map** tool to create a 2-dimensional map representing the stratigraphy along a horizontal slice, at a specified elevation. This is stored as a RockWorks grid model (GRD), and the map is displayed in the RockPlot2D window.

Notes: Be sure the stratigraphic names are correctly defined in the current Stratigraphy Types Table. See Missing Formations (page 61) for tips on how to enter your stratigraphy data.

Help / Contents / Borehole Manager/ Stratigraphy Tools / Creating Stratigraphy Plan-View Maps.

Manually Building 3D Stratigraphic Diagrams



The RockWorks Utilities **Grid** / **Grids -> Stratigraphic Model** tool is used to create a 3D stratigraphic model diagram based on a list of existing grid models that represent the top ("superface") and base ("subface") of each unit. These are grid models that must already exist on your computer.

This program is designed for two types of applications:

Users who have created their grid models within other applications (e.g. ModFlow, Surfer) and wish to use RockWorks to create stratigraphic (or hydrostratigraphic) diagrams.

Users who have created their grid models within the Borehole Manager portion of RockWorks but need more flexibility in dealing with stratigraphic relationships (e.g. special manipulations with the grids).

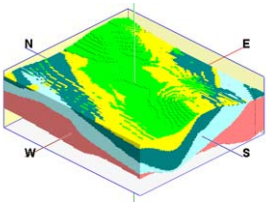
This is a “manual” way of creating the kind of stratigraphic model that’s available in the Borehole Manager’s **Stratigraphy** / **Model** tool.

Datasheet: RockWorks Utilities. This tool reads a “stratigraphy gridlist” data file (page 82).

Notes: Be sure the grid models that are listed in the datasheet actually exist in the current project folder. Use the "cutoff" setting to erode thin layers.

Help / Contents / Borehole Manager/ Grid Model Tools / Stratigraphic Tools / Manually Building 3D Stratigraphic Diagrams.

Manually Building 3D Stratigraphic Solid Models



This RockWorks Utilities tool is used to create a 3D stratigraphic solid model (*.MOD) based on a list of existing grid models that represent the top ("superface") and base ("subface") of each unit. This program is similar to Grids -> Stratigraphic Model except that this program creates a numeric solid model (that can be subsequently manipulated) whereas the Grids -> Stratigraphic Model program just creates a diagram.

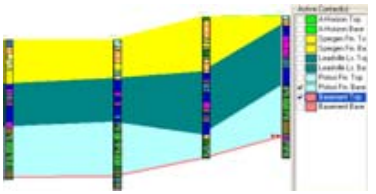
Notes:

- The grid models must already exist on your computer.
- The grid models must match the XY dimensions and node density of the current project dimensions.

Datasheet: RockWorks Utilities. This tool reads a "stratigraphy gridlist" file (page 82).

Help / Contents / Borehole Manager/ Grid Model Tools / Stratigraphic Tools / Manually Building 3D Stratigraphic Solid Models.

Picking Stratigraphic Contacts



Use the Borehole Manager's **Stratigraphy** / **Pick Contacts** tool to determine depths to stratigraphic tops (and bases) from geophysical, raster, lithology, or other log data.

This is one of the most powerful tools in this program since it lets you visualize existing lithology blocks or geophysical curves in a 2D display, and then point-and-click to pick the stratigraphic contacts. The contact depths are recorded in the project's Stratigraphy tabs.

! This tool will assign formation depths assuming vertical boreholes. If your boreholes are deviated, you may need to eventually edit by hand the picked formation depths, based on how the stratigraphic surfaces or log intervals look when displayed in diagrams that can accommodate the borehole's deviated downhole trace.

We encourage you to follow very carefully the steps listed in the How To section of the Help messages which are summarized below.

1. Enter your known data: Typically this would be lithology intervals down the hole, or

geophysical (elog) measurements.

2. Build a log section: This is not required, but it's helpful to be sure your data is good, for setting up the proper section alignment, for viewing the known data to be picked from, and for determining the formations that are present.
3. Create a Stratigraphy Types Table: With a good idea of the look of the existing downhole lithology or geophysical data, you need to create a "Stratigraphy Types Table" which lists the names of the formations, from the surface downward, that are represented in your project.
4. Set up the formation picker display: This should be set up just like the hole to hole section in step 2.
5. Pick the wells to be displayed: You can choose the same boreholes as were chosen in step 2, or pick a new selection of wells.
6. Pick the first formation in the Contact Picker window: Select the name of the formation to be recorded and left-click on each log where that formation's top is displayed. The program will record the depths in the table. Right-click on each log at the formation's base, and these will be recorded.
   Note that you can add formation names to the Stratigraphy Types Table while you are in the Contact Picker window.
7. Pick the next formations: Select the name of the next formation to be recorded, left-click to pick tops and right-click to pick bases. Continue in this manner for additional formations.
8. End the session: Click on the Exit button and discard, save, or adjust-and-save changes.

What next? Now that you have the stratigraphic units defined, use the **Stratigraphy** / **Model** tool to create a 3-dimensional solid model of the units. The **Stratigraphy** menu also offers display of structural surfaces, thicknesses, profiles, sections, fences, and plan-view and stratigraphy surface maps. Create 3-Dimensional log displays of the borehole data, and append them to the stratigraphic model.

Help / Contents / Borehole Manager/ Stratigraphy Tools / Picking Stratigraphic Contacts.

Filling in Missing Stratigraphy

Use the Borehole Manager's **Stratigraphy** / **Fill in Missing Stratigraphy** tool to insert missing units into each borehole's Stratigraphy tab, setting them to zero thickness. This relies on the formation order defined in the Stratigraphy Types table and provides a means of adding control for surface interpolation. You can opt for creating a backup of the project database before continuing with this operation.

See also: Missing Formations (page 61).

Help / Contents / Borehole Manager / Stratigraphy Tools

Consolidating Stratigraphy

Use the Borehole Manager's **Stratigraphy** / **Consolidate** tool to locate identical, contiguous stratigraphic intervals (without regard for any associated comments) and consolidate them into a single interval. This utility is primarily designed for users who are importing data from other programs that store data at uniform intervals.

Help / Contents / Borehole Manager / Stratigraphy Tools

Creating a Stratigraphic Volume Report (Solid Model)

Use the Borehole Manager's **Stratigraphy** / **Volumetrics (Based on Solid Model)** tool to read a saved stratigraphic solid model and compute the total volume or mass for each stratigraphic layer as a function of the relative depth/elevation. The resulting computations are displayed in the RockWorks Utilities datasheet.

Input: This tool reads data from an existing stratigraphic solid model (MOD file) created if Save Model is checked in the **Stratigraphy** / **Model** menu item (page 128).

Output window: RockWorks Utilities datasheet

Notes:

You can select from the following results: Nodes, Volume, Mass, or Percent.. Nodes reports the numbers of nodes of each stratigraphic type at each elevation slice. Volume will be reported in cubic units (typically meters or feet, depending on your X, Y, and depth/elevation units). If you select the Mass option, these computations are based on the Density Factor declared in the current Stratigraphy Types Table which declare mass per cubic unit. Percent represents the percent volume of each stratigraphy type at each elevation level. Multiple units can be selected.

Because this is based on a voxel model, the vertical spacing of the model nodes (defined in the Project Dimensions) will have a large effect on the resulting volume computations.

Help / Contents / Borehole Manager/ Stratigraphy Tools / Creating a Stratigraphic Volume Report.

Creating a Stratigraphic Volume Report (Grid Models)

Use the Borehole Manager's **Stratigraphy** / **Volumetrics (Based on Grid Models)** tool to compute volume of each unit as determined by the grids that are generated during by **Stratigraphy** / **Model** program. Because it is not solid-model-based, this eliminates the need to adjust the solid model z-spacing (voxel height) for optimum accuracy. The resulting computations are displayed in the RockWorks Utilities datasheet.

Input: This tool reads data the grid models (GRD) that are created for each stratigraphic unit via the **Stratigraphy** / **Model** menu item (page 128).

Output window: RockWorks Utilities datasheet

Notes:

You can request both Volume and Mass. Volume will be reported in cubic units (typically meters or feet, depending on your X, Y, and depth/elevation units). If you select the Mass option, these computations are based on the Density Factors declared in the current Stratigraphy Types Table which declare mass per cubic unit.

Help / Contents / Borehole Manager/ Stratigraphy Tools / Creating a Stratigraphic Volume Report.

Exporting Stratigraphy Data to ASCII

Use the Borehole Manager's **Stratigraphy** / **Export / ASCII XYZ File** tool to export stratigraphy depth, elevation, or thickness data for each borehole to an ASCII (Text) XYZ file. The resulting file will contain the X and Y location coordinates for the formation contact in each borehole (taking into account any boring deviation or inclination), and the selected depth, upper elevation, lower elevation, or thickness. (Thickness is drilled thickness, as recorded in the Stratigraphy tab, not grid-based thickness.) This file can be imported into the RockWorks RockWorks Utilities datasheet or into other applications, or opened automatically into the default Windows text editor (such as Notepad).

Output window: ASCII XYZ file representing observed depth, upper elevation, base elevation, or thickness.

Notes:

To load this exported file into the RockWorks Utilities datasheet, follow these steps: Click on the RockWorks Utilities tab, choose **File** / **New Datasheet**, select the "Generic XYZ" format for the layout, and use the **File** / **Import** / **Into RockWorks Utilities** / **ASCII** option to import the text file into the data window.

Help / Contents / Borehole Manager/ Stratigraphy Tools / Exporting Stratigraphy Data.

Exporting Stratigraphy Thickness to the Utilities Datasheet

Use the Borehole Manager's **Stratigraphy** / **Export / Hanson Aggregates Stratigraphic Thickness Report** tool to export to the RockWorks Utilities datasheet a listing of the thickness of all stratigraphic units of all boreholes.

The list will contain the name of the borehole, the name of the unit, the unit thickness, and a blank Key column. The latter is for subsequent classification use within non-RockWare software.

Help / Contents / Borehole Manager/ Stratigraphy Tools / Exporting Stratigraphy Data.

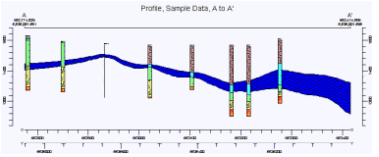
Chapter 7 - Water Levels: Display as Profiles, Sections, Plans, Fences, and Blocks

Creating Water Level Diagrams - Overview

Use the tools in the Borehole Manager **Aquifer** menu to visualize your water level data (listed in the project's Water Level tabs) in a variety of ways: Create 2D profiles and surface maps, 3D fences and block diagrams of the upper and lower surfaces. These can be particularly useful when combined with other 2D and 3D diagrams of your project (as in the example above, combined with a stratigraphy diagram). The water levels are modeled using surface modeling or gridding tools.

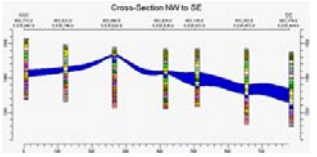
Help / Contents / Borehole Manager/ Aquifer Tools

Creating a Water Level Profile Diagram



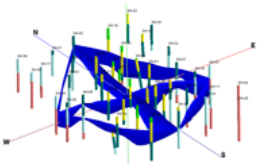
Use the Borehole Manager's **Aquifer** / **Profile** tool to create a 2D vertical profile of a single aquifer listed for a particular date or date range in the Water Levels tab. The profile can be drawn between any two points in the study area. The profile can be color- or pattern-filled. During the process of building the profile, the program will create a grid model of the upper and lower surface of the aquifer using the user-selected gridding method. You can request an automatic map representing the location of the profile cut. There is an option to create multiple, parallel profiles automatically. Notes: The grid models will be named automatically: "*date*_top.grd" and "*date*_base.grd." See page 157 for information about drawing the profile slice.

Creating a Water Level Section Diagram



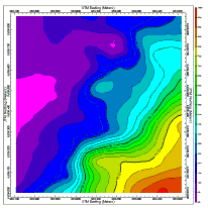
Use the Borehole Manager's **Aquifer** / **Section** tool to create a 2D vertical multi-panel profile of a single aquifer listed for a particular date or date range in the Water Levels tabs. The panel endpoints can be anywhere within the project area. The profile can be color- or pattern-filled. During the process of building the section, the program will create a grid model of the upper and lower surface of the aquifer using the user-selected gridding method. Logs can be appended, and a map representing the section location can be created automatically. Notes: The grid models will be named automatically: "*date*_top.grd" and "*date*_base.grd." See page 159 for information about drawing the section slice.

Creating a Water Level Fence Diagram



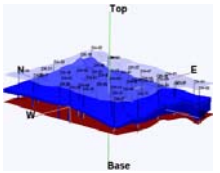
Use the Borehole Manager's **Aquifer** / **Fence** tool to create a 3-dimensional fence diagram that illustrates the aquifer at a selected date or date range. You may request regular panel spacing, in a variety of configurations, or you can draw your own panels. During the process of building the fence panels, the program will create a grid model for the upper and lower surface of the aquifer layers using the user-selected gridding method. 3D logs can be appended, and you can request a map representing the fence panel locations. The completed fence diagram will be displayed in a RockPlot3D window, where you can manipulate the image and append other 3D images. Notes: The grid models will be named automatically: "*date*_top.grd" and "*date*_base.grd." See page 161 for information about drawing the fence panels.

Creating a 2D Water Level Surface or Thickness Map



Use the Borehole Manager's **Aquifer** / **Plan** tool to create a 2-dimensional (flat) contour map of the aquifer surface, base, or thickness for a particular date or date range. During the process of building the contour map, the program will create a grid model for the upper and lower surfaces of the aquifer, and of the aquifer thickness, using the user-selected gridding method. The grid models will be stored as ".grd" files on disk.

Creating a Water Level Block Diagram



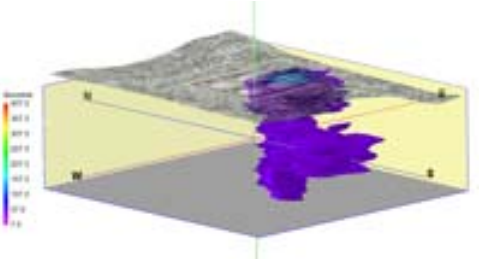
Use the Borehole Manager's **Aquifer** / **Model** tool to create a 3-dimensional block diagram that illustrates a selected aquifer layer at a particular date or over a specified date range. The later will be displayed in the color of your choice. During the process of building the block diagram, the program will create a grid model for the upper and lower surface of the aquifer using the user-selected gridding method. These grid models will be stored in the project folder. The completed diagram will be displayed in a RockPlot3D window, with the upper surface, lower surface, and side panels. Volume of the aquifer will be displayed in the RockPlot3D window. The aquifer block can be combined with other 3D diagrams, such as the stratigraphy block diagram above. The grid models will be named: "*date*_top.grd" and "*date*_base.grd."

Exporting Water Level Data

Use the Borehole Manager's **Aquifer** / **Export** tool to export water level depth, elevation, or thickness data for each borehole for a selected date or date range to an ASCII (Text) XYZ file.

Chapter 8 - Creating Solid Models, and Voxel/Isosurface, Profile, Section, Fence, Plan and Surface Diagrams

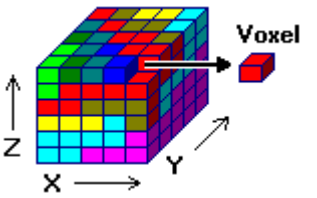
Solid Modeling Introduction



Solid modeling is a true 3-dimensional gridding process, used to create a “box” of regularly-spaced nodes from your irregularly-spaced data. For known X, Y, and Z points in space (such as boreholes) the program can interpolate measured values such as geochemistry, geophysical measurements, even lithology types, or any other downhole or subsurface quantitative value.

The RockWorks Utilities **Solid** / **Model** tool creates solid models from X, Y, Z, and G data listed in the main datasheet or in an external ASCII file. The Borehole Manager **Lithology**, **I-Data**, **P-Data**, and **Fractures** menu tools (**Profile**, **Section**, **Fence** and **Model**) create solid models from lithology, interval- or point-sample quantitative data, or fracture data in the respective data tabs.

Once it knows the dimensions of your study area, the program divides it into three-dimensional cells or "voxels," their dimensions automatically or user-determined. Each voxel is defined by its corner points or nodes. Each node is assigned the appropriate X, Y, and Z location coordinates according to its relative placement within the study area. A fourth variable, "G", which can represent grade of ore, concentration of pollutants, etc., is estimated based on the G value of the given data points.



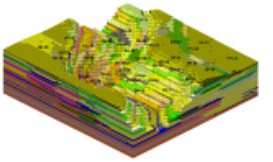
There are several methods offered to do this interpolation of your data. Each operates differently, and each has strengths and differences. These are discussed under Solid Modeling Methods in the Reference section.

What Can I do with a Solid Model?

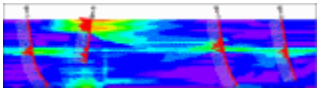
Once you have a solid model (or ".MOD") file created, illustrating the distribution of your geochemistry, geophysical measurements, lithology, or other measured values, it can be used in a variety of ways:

View it:

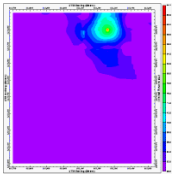
Illustrate it as a 3-dimensional voxel or isosurface diagram, as in this 3D lithology voxel diagram.



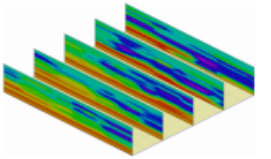
Display a vertical slice of the model as a 2-dimensional section (multiple slices) or profile (1 slice) as in this 2D geochemistry profile diagram.



Display a horizontal slice of the model as a 2-dimensions "plan" map, as in this example from a geochemistry model.



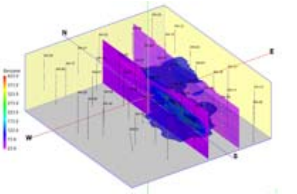
Display multiple vertical slices of the model as a 3-dimensional fence diagram, as in this example from a p-data model.



Manipulate it:

Use the RockPlot3D window to visually manipulate solid models, setting high and/or low G value nodes to transparent, inserting slices, rotating the display.

Use the RockWorks Utilities **Solid** menu tools to filter models, perform computations on nodes, edit models, and more.

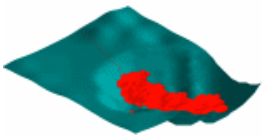


Compute its volume (and mass):

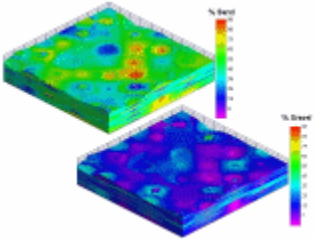
Volume is automatically computed for the solid models (and updated as filters are applied) when displayed in RockPlot3D.

Create a detailed volume report of the model after filtering it based on G values, surface polygons, overburden ratios, and more.

Create a simplified pit design by fitting a grid surface below specified zones of a solid model.



RockWorks Utilities: Creating a Solid Model of XYZG Data



If you have X,Y,Z,G data displayed in the RockWorks Utilities datasheet, or stored in an external ASCII file, you can use the **Solid** / **Model** tool to create solid models of this data. The X (Eastings), Y (Northings) and Z (elevation) coordinates note the sample locations, and "G" represents the measured value to be modeled. G can represent geochemical concentrations, geophysical measurements, etc. A variety of modeling algorithms are available. The **Solid** / **Model** tool is also used to create 3-dimensional diagrams to illustrate solid models.

The **Solid** / **Profile** tool displays a single, vertical slice of the solid model in 2D; and the **Solid** / **Section** tool displays multiple, connected profile slices of the solid model in 2D. The **Solid** / **Plan** tool displays a single, horizontal or plan-view slice in 2D; and the **Fence** tool displays multiple vertical slices in 3D.

! If you have geochemical, geophysical, or lithology data from boreholes, recorded as depths and measured values, use the Borehole Manager's tools to create solid models and corresponding diagrams. (See next topic.)

Datasheet: RockWorks Utilities "XYZG" file (see 79).

Notes: You can use this tool to create a solid model only (e.g. no diagram). You can use this tool to create a 3-D diagram from an already-existing solid model (e.g. no new model).

! Use the Project Manager to create a quick voxel or isosurface diagram that illustrates your solid model: just double-click on a MOD file name and establish the diagram settings. (See page 101.)

Help / Contents / RockWorks Utilities / Solid Model Tools.

Borehole Manager: Creating Lithology Models and Voxel, Fence, Profile, Section, Surface and Plan Map Diagrams

Creating Lithology Models and Diagrams - Overview

Use the tools in the Borehole Manager's **Lithology** menu to interpolate your downhole lithology data into a solid model, and visualize the interpolated model using a variety of diagram types - a vertical profile or cross section, a fence diagram with any number and arrangement of panels, a plan-view slice, a “geology” map where lithology intersects a surface, and a 3D voxel diagram.

The lithology descriptions are read from the Lithology tab, which lists depths and observed rock types. Unlike stratigraphy listings, lithology descriptions can repeat, and don't need to be listed in the same order in each boring.

Because of this, RockWorks does not use surface modeling tools to display lithology, but rather, *solid* modeling tools. There is a specific solid model algorithm designed to interpolate lithology from depth intervals in borings out to a solid model, called "lithoblend." The resulting solid model can be sliced vertically (profile, section, and fence diagrams), sliced horizontally (plan map), displayed on a surface, and/or displayed as a 3D block.

Lithology types are represented in the solid model as integer values, based on the "G" value you have listed for each rock type in the Lithology TypeTable (page 253). For example, "gravel" might be coded with a "1", and "sand" with a "5," for example. In the output diagrams, each lithology is represented using the background color you've selected for its pattern, also in the Lithology Types Table.

Notes:

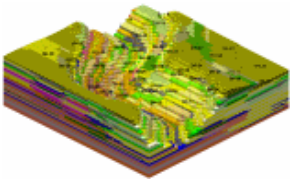
- The lithology keywords are listed in the project’s Lithology Types Table (page 253).
- For lithology models, the program will use the Horizontal Lithoblending algorithm because it was designed specifically to model lithology types.
- Optional surface filtering is available to zero-out nodes above a surface model (such as the ground surface) or a stratigraphic unit, and/or below a unit. Additional options include applying a regional tilt to the modeling, as well as warping the lithology model based on a surface.

- Once you have the solid model file created, you can use that existing model for future block, fence, profile, section, and plan diagrams. (They can all share the same MOD file without having to recreate it each time; choose Use Existing Model in the diagram's Options window.)
- See page 157 for information about drawing profile, section, and fence panel traces.
- See page 181 for information about lithology volume tools.

Help / Contents / Borehole Manager/ Lithology Tools

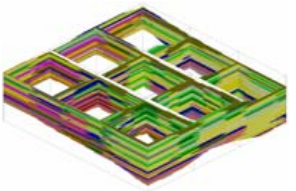
Lithology Diagrams

Lithology / Model



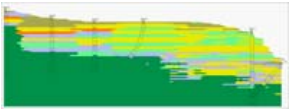
Use the Borehole Manager's **Lithology** / **Model** tool to create a 3-dimensional voxel diagram that illustrates lithology types. The lithologies will be color-coded based on their background colors in the Lithology Types Table. During the process of building the block diagram, the program will create a solid model of the lithologies using the "lithoblend" algorithm. 3D striplogs can be appended. Selected lithology types can be displayed and volumes computed.

Lithology / Fence



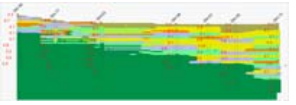
Use the Borehole Manager's **Lithology** / **Fence** tool to interpolate a solid model or read an existing model representing lithology and create a 3-dimensional fence diagram that illustrates material types with color-coded panels. You may request regular panel spacing, in a variety of configurations, or you can draw your own panels. 3D logs can be appended.

Lithology / Profile



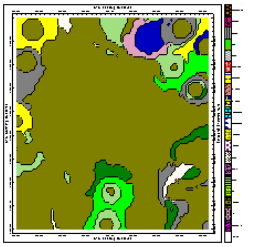
Use this tool to to interpolate a solid model or read an existing model representing lithology and create a 2-dimensional (flat) vertical profile, between any two points in the study area. The profile layers are color-coded based on rock type. Striplogs can be projected onto the panel plane. There is an option to create multiple, parallel profiles automatically.

Lithology / Section



This tool is used to interpolate a solid model or read an existing model representing lithology and create a 2-dimensional, vertical, multi-paneled section of lithology. The section panel endpoints can be drawn anywhere in the study area. The section's layers are color-coded based on rock type. Striplogs can be appended at panel junctions.

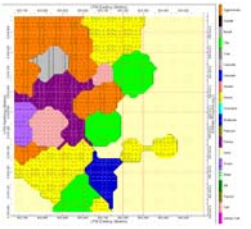
Lithology / Surface Map



Use this tool to interpolate a solid model or read an existing model representing lithology and create a 2-dimensional map representing the lithology where it intersects a designated surface, typically the surface topography. In other words, it creates a geological map based on downhole lithology data. This is stored as a RockWorks grid model (GRD), and the map is displayed in the RockPlot2D window.

Notes: You need to be sure that the dimensions and node density of the grid model and the solid model are the same.

Lithology / Plan Map



The **Lithology** / **Plan Map** tool is used to interpolate a solid model or read an existing model representing lithology and create a 2-dimensional map representing the lithology along a horizontal slice, at a specified elevation. This is stored as a RockWorks grid model (GRD), and the map is displayed in the RockPlot2D window.

Exporting Lithology Data

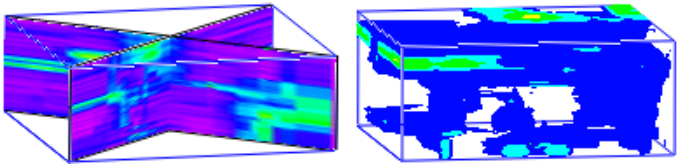
Use the Borehole Manager's **Lithology** / **Export** options to export lithology data to the following:

ASCII XYZG: Extract X,Y,Elevation coordinates and lithology "G" values from the borehole database, and store them in an XYZG file.

I-Data: Transfers lithology observations to a track in the project's I-Data table, converting lithotype to quantitative value based on a lookup table (representing porosity, permeability, conductivity, etc.)

Borehole Manager: Creating Solid Models of Downhole Interval Data and Isosurface/Voxel, Fence, Profile, Section, and Plan Map Diagrams

Creating I-Data Diagrams - Overview



Use the tools in the Borehole Manager's **I-Data** menu to interpolate your downhole interval-based data (representing geochemistry, geotechnical measurements, etc.) into a solid model, and to visualize the interpolated model using a variety of diagram types - a vertical profile slice, a multi-panel "section," a 3D fence diagram with any number and arrangement of panels, a horizontal slice or plan map, and as a 3D isosurface or voxel diagram.

Downhole data that was recorded for depth intervals (as opposed to point measurements) is entered into the Borehole Manager's Intervals (I-Data) tabs. The I-Data tabs will show two columns of depth listings, for each interval's top and bottom depth (uppermost intervals listed first) and one or more columns of measured values. The data can represent assay values, pollutant concentrations, aggregate quality or grain size, etc. (Point-measured data is entered into the Points (P-Data) tab.)

Notes:

- Several modeling methods or algorithms are offered for the interpolation of the data into a solid model.
- Optional surface filtering is available to zero-out nodes above a surface model (such as the ground surface) or a stratigraphic unit, and/or below a unit. Additional options include applying a regional tilt to the modeling, as well as warping the I-Data model based on a surface.
- Once you have the solid model file created, you can use that existing model for future isosurface, fence, profile, section, and plan diagrams. (They can all share the same MOD file without having to recreate it each time; choose Use Existing Model in the diagram's Options window.)
- Automatic maps illustrating the location of profile, section, and fence panels can be created.
- See page 157 for information about drawing profile, section, and fence panel traces.
- See page 182 for information about generating detailed I-Data volume reports.

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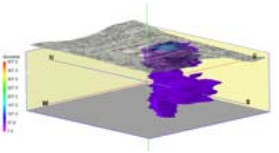
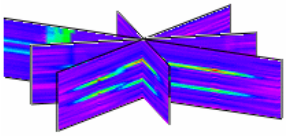
I-Data Diagrams

I-Data / Model



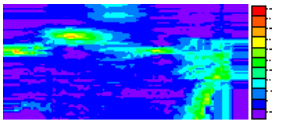
Use this tool to interpolate a solid model or read an existing model representing your downhole I-Data values, and to create a 3-dimensional isosurface or voxel diagram that illustrates the model. The data values can be color-coded in a variety of ways. 3D striplogs can be appended. Once displayed in RockPlot3D the isosurface or voxel display can be filtered for viewing specific data ranges, and volumes can be displayed.

I-Data / Fence



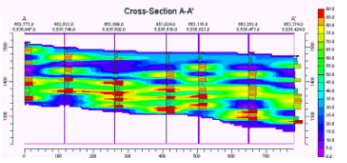
This tool interpolates a solid model or read an existing model representing your downhole I-Data values, and creates a 3-dimensional fence diagram that illustrates the model. You may request regular panel spacing, in a variety of configurations, or you can draw your own panels. The model's data values can be color-coded in a variety of ways. 3D striplogs can be appended. Notes: See page 161 for information about drawing the fence panels.

I-Data / Profile



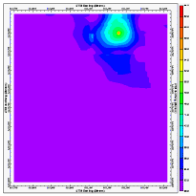
Use this tool to interpolate a solid model or read an existing model representing your downhole I-Data values, and create a 2-dimensional (flat) vertical profile diagram, sliced anywhere in the study area. The data values can be color-coded in a variety of ways. Striplogs can be appended. There is an option to create multiple, parallel profiles automatically.

I-Data / Section



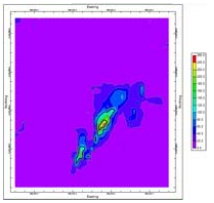
This tool interpolates a solid model or reads an existing model representing your downhole I-Data values and creates a 2-dimensional vertical multi-panel profile diagram. The panel endpoints can be placed anywhere in the project. The data values can be color-coded in a variety of ways. Striplogs can be appended.

I-Data / Plan



This tool interpolates a solid model or reads an existing model representing your downhole interval data and slices it horizontally at a user-specified elevation. The resulting grid model (GRD) can be displayed as a 2-dimensional map in which the data values can be color-coded in a variety of ways.

I-Data / Surface



This tool interpolates a solid model or reads an existing model representing your downhole interval data and extracts the G values where they intersect a surface (GRD file). The resulting grid model (GRD file) can be displayed as a 2- or 3-dimensional map in which the data values can be color-coded in a variety of ways.

Exporting I-Data

Use the Borehole Manager's **I-Data** / **Export** and **Extract** options to export the interval data to the following:

Export / **ASCII XYZG**: Extract X,Y,Elevation coordinates and G values for a selected track from the borehole database, and store them in an XYZG file.

Export / **ASCII CSV**: Exports all tracks of I-data measurements for the current/enabled/all boreholes to an ASCII comma separated variable (CSV) file for use in Excel.

Extract: Extracts project I-Data measurements for a selected track that lie within two GRD surfaces (e.g. stratigraphic unit) and lists the XYZG values in the RockWorks Utilities datasheet.

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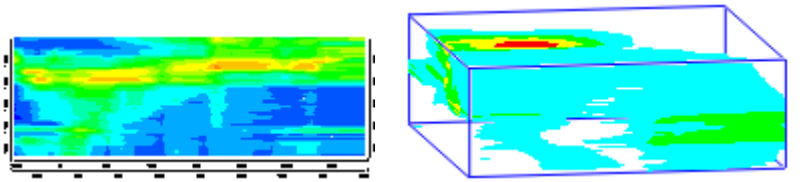
Borehole Manager: Creating Solid Models of Downhole Point Data and Isosurface/Voxel, Fence, Profile, Section, and Plan Map Diagrams

Creating P-Data Diagrams - Overview



Use the tools in the Borehole Manager's **P-Data** menu to interpolate your downhole point-sampled data (such as geophysical measurements) into a solid model, and to visualize the interpolated model in a variety of ways: as a vertical profile slice, a multi-paneled profile or "section,", a 3D fence with any number and arrangement of panels, a horizontal slice or plan map, and as a 3D isosurface or voxel diagram.

Downhole data that was recorded at depth points (as opposed to depth intervals) is entered into the Borehole Manager's Points (P-data) tabs. The P-data tabs will show one column of depth listings and one or more columns of measured values. The data can include all types of geophysical (elog) data: resistivity, gamma,etc. By contrast, data measured at depth *intervals* is entered into the I-data tab.

Notes:

- Several modeling methods or algorithms are offered for the interpolation of the data into a solid model.
- Optional surface filtering is available to zero-out nodes above a surface model (such as the ground surface) or a stratigraphic unit, and/or below a unit. Additional options include applying a regional tilt to the modeling, as well as warping the P-Data model based on a surface.
- Once you have the solid model file created, you can use that existing model for future isosurface, fence, profile, section, and plan diagrams. (They can all share the same MOD file without having to recreate it each time; choose Use Existing Model in the diagram's Options window.)
- Automatic maps illustrating the location of profile, section, and fence panels can be created.
- See page 157 for information about drawing profile, section, and fence panel traces.

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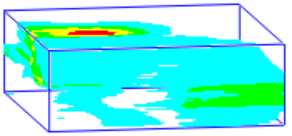
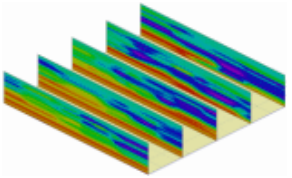
P-Data Diagrams

P-Data / Model



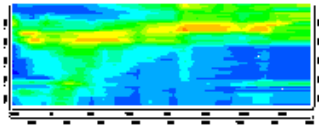
Use this tool to interpolate a solid model or read an existing model representing your downhole P-Data values, and to create a 3-dimensional isosurface or voxel diagram that illustrates that model The values can be color-coded in a variety of ways. 3D striplogs can be appended. Once displayed in RockPlot3D the isosurface or voxel display can be filtered for viewing specific data ranges, and volumes can be displayed.

P-Data / Fence



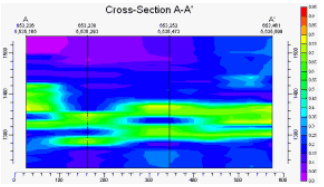
The **P-Data** / **Fence** tool is used to interpolate a solid model or read an existing model representing your downhole P-Data values, and create a 3-dimensional fence diagram that illustrates the model. You may request regular panel spacing, in a variety of configurations, or you can draw your own panels. The model's values can be color-coded in a variety of ways. 3D striplogs can be appended. See page 161 for information about drawing the fence panels.

P-Data / Profile



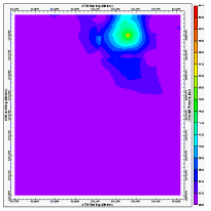
Use the Borehole Manager's **P-Data** / **Profile** tool to interpolate a solid model or read an existing model representing your downhole P-Data values, and create a 2-dimensional (flat) vertical profile, sliced between any two points in the study area. The data values can be color-coded in a variety of ways. Striplogs can be appended. There is an option to create multiple, parallel profiles automatically.

P-Data / Section



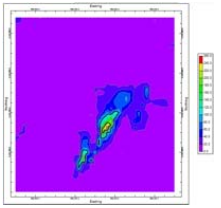
Use this tool to interpolate a solid model or read an existing model representing your downhole P-Data values, and create a 2-dimensional vertical multi-panel profile of the model. The panel endpoints can be placed anywhere in the project. The data values can be color-coded in a variety of ways. Striplogs can be appended.

P-Data / Plan



The **P-Data** / **Plan Map** tool interpolates a solid model or reads an existing model representing your downhole point data and slices it horizontally at a user-specified elevation. The resulting grid model (GRD) can be displayed as a 2-dimensional map in which the data values can be color-coded in a variety of ways.

P-Data / Surface



This tool interpolates a solid model or reads an existing model representing your downhole point data and extracts the G values where they intersect a surface (GRD file). The resulting grid model (GRD file) can be displayed as a 2- or 3-dimensional map in which the data values can be color-coded in a variety of ways.

P-Data Manipulation Tools

Use the options in the P-Data / Analyze menu to perform the following data manipulations:

- Add Random: Adds random numbers to a p-data track.
- Gamma Counts -> Uranium Grade: Reads Gamma measurements from a P-Data track and converts the data to uranium grade values in an I-Data track. Conversion constants can be uniform or pulled from custom fields in each borehole's Location tab.
- Logarithm: Computes the logarithm of a given p-data column. Logarithmic conversions are useful when you want to show the variations within the low values despite high values that otherwise "squish" the curve when using the autoscale option.
- Resample: Resamples a P-Data track, storing them in a new output track. Filters are also available. This can be helpful if your source data is sampled at too fine an interval to be practical for modeling or log display.

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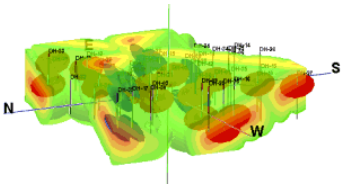
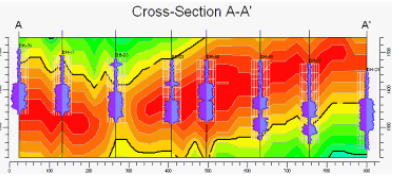
Borehole Manager: Creating Solid Models of Downhole Fracture Data and Isosurface/Voxel, Fence, Profile, Section, and Plan Map Diagrams

Creating Fracture Diagrams - Overview





Use the tools in the Borehole Manager's **Fractures** menu to generate a solid model of fracture locations and display this model in a variety of ways: as a vertical profile slice, a multi-paneled profile or "section,", a 3D fence with any number and arrangement of panels, a horizontal slice or plan map, and as a 3D isosurface or voxel diagram.

Downhole fracture data is entered into the Borehole Manager's Fractures tabs. The fractures are listed with depth, fracture orientation, and dip angle, radius and thickness. In addition, color is specified for the fracture disc as displayed in 3d logs. The radius, listed in your map units, affects the size of the disc in logs and, for modeling purposes, the extent of the influence of the fracture.

Notes:

- A specific modeling method is used for the interpolation of the fracture model. Fracture model G values represent *distance* to the closest fracture, so that low values represent proximal fractures, and high values represent areas where fractures are not prevalent. For this reason, there's an option to "negate" the node values (e.g. multiply by -1) so that you can isolate the highs rather than the lows.
- Optional surface filtering is available to zero-out nodes above a surface model (such as the ground surface) or a stratigraphic unit, and/or below a unit.
- Once you have the solid model file created, you can use that existing model for future isosurface, fence, profile, section, and plan diagrams. (They can all share the same MOD file without having to recreate it each time; choose Use Existing Model in the diagram's Options window.)
- Automatic maps illustrating the location of profile, section, and fence panels can be created.
- See page 157 for information about drawing profile, section, and fence panel traces.

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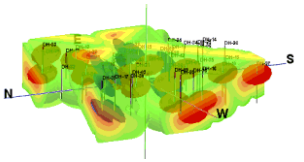
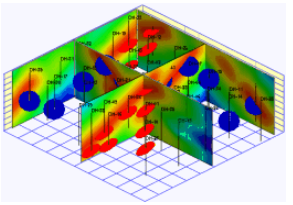
Fractures / Model



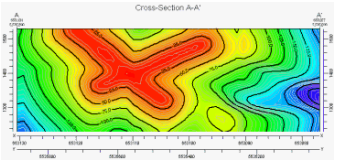
Use the Borehole Manager's **Fractures** / **Model** tool to interpolate a solid model or read an existing model representing fracture proximity and create a 3-dimensional isosurface or voxel diagram that illustrates that model. The values can be color-coded in a variety of ways. 3D striplogs can be appended.

Fractures / Fence



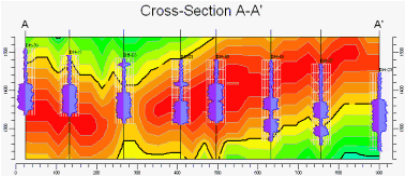
Use this tool to interpolate a solid model or read an existing model representing fracture proximity and create a 3-dimensional fence diagram that illustrates that model. You may request regular panel spacing, in a variety of configurations, or you can draw your own panels. The model's values can be color-coded in a variety of ways. 3D striplogs can be appended.

Fractures / Profile



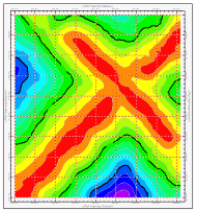
Use this tool to to interpolate a solid model or read an existing model representing fracture proximity and create a 2-dimensional vertical profile that illustrates that model, between any two points in the study area. The data values can be color-coded in a variety of ways. Striplogs can be appended. There is an option to create multiple, parallel profiles automatically.

Fractures / Section



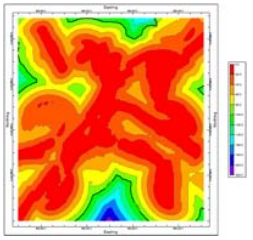
The **Fractures** / **Section** tool interpolates a solid model or reads an existing model representing fracture proximity and creates a 2-dimensional vertical multi-panel profile that illustrates the model. The panel endpoints can be placed anywhere in the project. The data values can be color-coded in a variety of ways. Striplogs can be appended.

Fractures / Plan Map



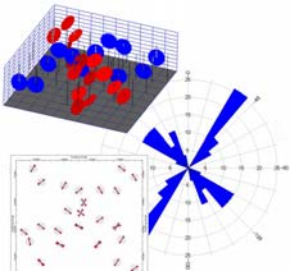
Use this tool to interpolate a solid model or read an existing model representing fracture proximity and slices it horizontally at a user-specified elevation. The resulting grid model (GRD) can be displayed as a 2-dimensional map in which the data values can be color-coded in a variety of ways.

Fractures / Surface Map



Use this tool to interpolate a solid model or read an existing model representing fracture proximity and extract the G values where they intersect a surface (GRD file). The resulting grid model (GRD file) can be displayed as a 2- or 3-dimensional map in which the data values can be color-coded in a variety of ways.

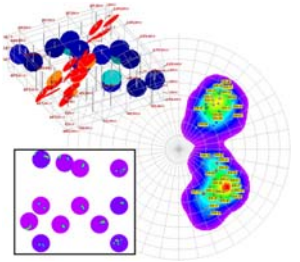
Fractures / Rose Diagram and Rose Diagram Map



Use the **Fractures** menu's **Rose Diagram** and **Rose Diagram Map** tools to read 2D fracture orientations (azimuths) from the borehole database and generate a single rose diagram for the current borehole, or a rose diagram map for all boreholes.

See the description of Rose diagrams (page 188) for information about their structure.

Fractures / Stereonet Diagram and Stereonet Diagram Map



Use the **Fractures** menu's **Stereonet** and **Stereonet Map** tools to read 3D fracture orientations (azimuths and inclinations) from the borehole database and generate a single stereonet diagram for the current borehole, or a stereonet diagram map for all boreholes.

See the description of Stereonet diagrams (page 191) for information about their structure.

Exporting Fracture Data

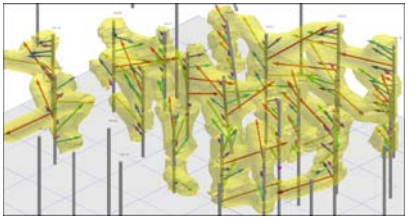
Use the Borehole Manager's **Fractures** / **Export** option to export the downhole depth/orientation/inclination data to the following:

Export / **ASCII file**: X, Y, elevation, direction, dip angle, radius, and aperture for all active boreholes will be written to an ASCII file.

Export / **Utilities Datagrid**: Exports ID, Depth, Easting, Northing, elevation, direction, dip angle, color, radius, aperture, and symbol to the RockWorks Utilities datasheet.

Borehole Manager: Creating Solid Models of Downhole Vector Data

Vectors / Model



Use the **Model** tool in the Borehole Manager's **Vectors** menu to convert directional downhole data into solid models that approximate the extents of the vectors. An example application is the generation of void geometries (cave models) based on downhole laser surveys.

The following operations are performed in order to generate a model that approximates cave geometries based on the vector data:

For each solid model node …

For each borehole ...

For each vector ...

- Compute the endpoint coordinates.
- Define a line connecting the endpoints.
- Define a sphere whose center is defined by the line midpoint and whose diameter is equal to the line length.
- If the node resides outside of the sphere it's g-value is set to "null" (-1.0E27).
- If the node resides inside of the sphere, it's g-value is set to the distance to the closest line.

Note: In order for the node values to increase with distance to the closest line, it is necessary to negate the distance values (i.e. the node values should be multiplied by -1) as allowed within the Vector Modeling Options menu.

Help / Contents / Borehole Manager/ Fracture Tools

Chapter 9 - Laying Out Vertical Profiles, Sections & Fences

During the process of building a vertical profile, cross section or fence diagram, RockWorks displays a window that illustrates the borehole locations, onto which you draw the section or fence panel line(s). The look of this window changes depending on the type of diagram being created, but the general operations are the same. If you are creating a profile, section, or fence from the RockWorks Utilities data window, the borehole locations will not be displayed.

Drawing a Profile Line

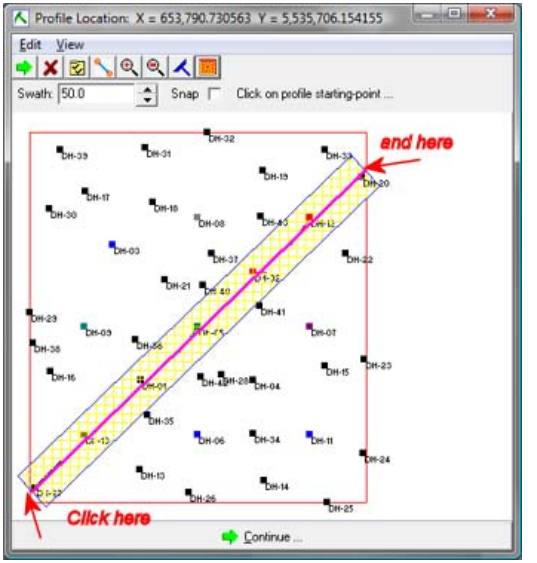
The Borehole Manager **Profile** tools are available within the **Lithology**, **Stratigraphy**, **I-Data**, **P-Data**, **Fracture** and **Aquifers** menus. They are used to display a vertical slice from the inside of a solid or stratigraphic model to illustrate lithology distribution, stratigraphic or water level elevations, geochemical/geophysical values, and fracture proximities. Striplogs can be included in any of these profile diagrams.

A **Profile** tool is also available within the RockWorks Utilities **Solid** menu, to slice an existing solid model containing any type of data.

In addition, log-only profiles are available using the **Striplogs** / **Multi-Log Profile** tool which displays multiple boreholes as if projected onto a vertical line of section.

Once you have set up the diagram settings, the program will scan the project database and display the well locations in the Profile Location window as a plan-view map, with boring name and symbol color tied to each well. Any previous line drawn for this project will also be displayed on the map. You may also turn on the display of the borehole traces if your wells are inclined or deviated. (Note: if you are using the **Solid** / **Profile** tool, only the project boundaries will be displayed.)

1. To accept the existing cross section cut as-is, simply click the ***Continue*** button at the bottom of the window.
2. Or, to draw a new profile line, along which the solid model will be sliced and/or onto which the logs will be projected, simply left-click on the map location to become the left edge of the profile and then left-click on the location to become the right edge of the profile. You do not need to refresh the screen between drawing lines.



The line can be oriented in the direction of your choice. You may redraw this line of section as many times as you like until you are pleased with its placement. Note that the prompt at the top of the window will read "Click on panel starting point" or "Click on panel ending point" to let you know what it's expecting.

3. For profiles containing logs, you can adjust the clipping distance or “swath”, shown above by the cross-hatched area. This represents the distance to either side of the actual profile line that boreholes (or portions of boreholes, if the well is deviated) will be "grabbed" for projection onto the line. You can change the clipping distance by clicking the up- or down-arrows at the top of the window, or by typing an actual value into the Swath prompt.
4. To snap the profile endpoints to actual well locations, insert a check in the ***Snap*** check-box. After you select the profile endpoints, they will be repositioned to the nearest boreholes.
5. If you want to type in specific endpoint coordinates, you can do so: Choose the **Edit** / **Manually Specify Endpoints** option. Type in the known X and Y coordinates for the beginning and ending points of the profile, and click the OK button.
   Back at the profile-drawing window, click the Redraw button (or choose **View** / **Redraw**) to redraw the screen with the new profile line.
6. If you want the program to create multiple, parallel profiles automatically, insert a check in the **Multiple Profiles** checkbox. The ***Options*** button can be used to define the multi-profile settings – the spacing, extents, orientation from the original line, and nature of the output graphic.
7. Click ***Continue*** when you are ready to continue.

The program will create the diagram and display it in the RockPlot2D window (page 207).

Note that if the profile line extends beyond the current project dimensions, it will be truncated to the project boundaries. If you would like to be warned that this truncation has taken place, you can activate the Warn if Outside Project setting under the Options menu.

See also: Help / Contents / Laying out Vertical Sections and Fences for additional topics.

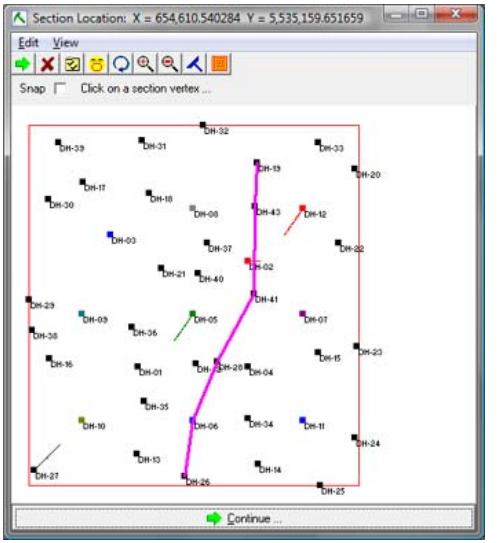
Drawing a Multi-Panel Cross Section Trace

The Borehole Manager **Section** tools are available within the **Lithology**, **Stratigraphy**, **I-Data**, **P-Data**, **Fracture** and **Aquifers** menus. They are used to display multiple, connected, vertical slices from the inside of a solid or stratigraphic model to illustrate lithology distribution, stratigraphic or water level elevations, geochemical/geophysical values, and fracture proximities. Striplogs can be included in any of these section diagrams.

A **Section** tool is also available within the RockWorks Utilities **Solid** menu, to slice an existing solid model containing any type of data.

In addition, log-only sections are available using the **Striplogs** / **Multi-Log Section** tool.

Once you have set up the diagram settings, the program will scan the project files and extract the borehole locations (Eastings and Northings) from the Location tab of each active borehole. It will display the well locations in the Select Boreholes window as a plan-view map, with boring name and symbol color tied to each well. Any previous panels drawn for this project will also be displayed on the map.



1. To accept the current selection, simply click the ***Continue*** button at the bottom of the

window to proceed.

2. To redraw the section line, follow these steps:

   Reset the display (if necessary): Rockworks will remember any panel selections from previous sessions. If you wish to discard any existing selections and start well-picking from scratch, click the **Edit** menu's **Reset** option. DON'T do this if you want to append to an existing section.

   Pick the first panel endpoint / Append another panel: Click on the location to be represented along the left edge of the first panel of the section. If you are appending to an existing trace, pick the location for the next panel to be added to the existing list. The program will draw a line from the last endpoint to this one.

   Pick the next endpoint, and the next and the next. Each selected panel point will be connected to the previous selection with a line.

3. To snap the panel endpoints to actual well locations, insert a check in the ***Snap*** check-box at the top of the window. After you select the panel endpoint pairs, they will be repositioned to the nearest boreholes.

   Lithology, modeled stratigraphy, i-data, p-data, fracture, and aquifer section panels can lie between boreholes - the slices can be placed anywhere within the model. However, if you choose to include striplogs in these section diagrams and if the panel endpoints don't lie at borehole locations, the program will simply project the closest log onto the panel.

   Straight stratigraphy sections must be drawn borehole to borehole, and the program will automatically snap panel endpoints to well locations.

4. Click ***Continue*** to accept the section trace.

The program will create the diagram and display it in the RockPlot2D window (page 207).

Notes:

Well Order: In a section diagram, the order in which the panel endpoints are selected will make a big difference in the appearance of the diagram. The first panel you select, regardless of its position in the map, will be at the left edge of the cross section, and the last will be at the right edge.

Mistakes? Choose the **Edit** / **Undo** option to remove the last-picked point. You can use this command repeatedly to remove panels in backward order. Or, choose **Edit** / **Reset** to clear the display and start over.

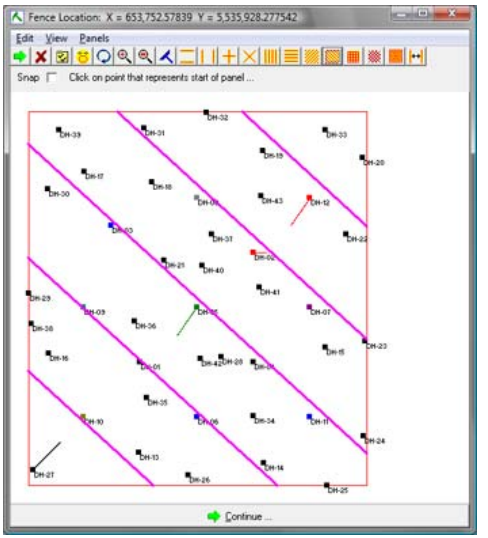
Section panels that extend beyond the current project dimensions will be truncated to the project boundaries. If you would like to be warned that this truncation has taken place, you can activate the Warn if Outside Project setting under the Options menu.

See also: Help / Contents / Borehole Manager/ Laying Out Vertical Sections and Fences for additional topics.

Drawing Fence Diagram Panels

The Borehole Manager **Fence** tools are available within the **Lithology**, **Stratigraphy**, **I-Data**, **P-Data**, **Fractures**, and **Aquifers** menus. They are used to display one or more vertical slices from the inside of a solid model to illustrate lithology distribution, stratigraphic or water level elevations, fracture proximity, or geochemical/geophysical values. A **Fence** tool is also available within the RockWorks Utilities **Solid** menu, to slice an existing solid model containing any type of data.

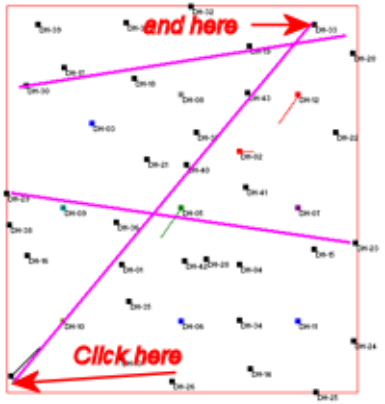
Once you have set up the diagram settings, the program will scan the project database and extract the borehole locations (Eastings and Northings) from the Location tab of each active borehole. It will display the well locations in the Fence Diagram Configuration window as a plan-view map, with boring name and symbol color tied to each well. Any previous lines drawn for this project will also be displayed on the map. You may also turn on the display of the borehole traces if your wells are inclined or deviated. (Note: if you are using the **Solid** / **Fence** tool, only the project boundaries will be displayed.)


Fence Location: X = 653,752.57839 Y = 5,535,928.277542
Edit View Panels
Snap
Click on point that represents start of panel ...
Continue ...

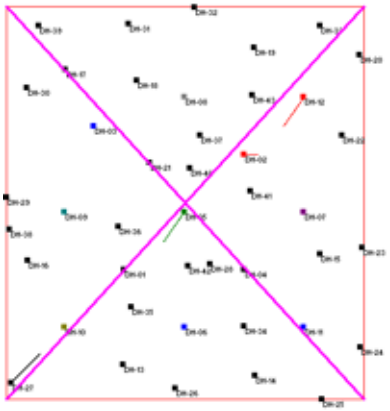
1. To accept any existing fence panel arrangement, simply click the ***Continue*** button at the bottom of the window to proceed. The program will build the fence diagram and display it in the RockPlot3D window.
2. To clear the current display to start over, choose the **Edit** / **Reset** option.
3. To draw a new fence panel or to add a new panel to the existing display, you have some options:

   Manually draw the line: Simply left-click on the map location to become the one edge of the cut and then left-click on the location to become the other edge of the cut. The program will connect the points with a line. For projected fence diagrams, the

slice endpoints do not need to correspond to borehole locations. For "straight" fence diagrams (**Stratigraphy** menu), the lines you draw will be snapped to the closest boreholes.



Pre-configured panels: Another option for fence panels is to select a pre-configured panel arrangement by choosing an option from the **Panels** menu or clicking the correspoinding button. For example, for an automatic "X" panel layout that extends to the edge of the solid model, choose the **Panels** / **Diagonal** option or the button.



As mentioned above, the slices do not need to conform to borehole locations for projected fence panels. They do for hole to hole fences (**Stratigraphy** menu) and the program will snap the drawn endpoints to the closest boreholes.

You can use any combination of hand-drawn and pre-configured panels that you wish.

4. To snap the panel endpoints to actual well locations, insert a check in the ***Snap*** check-

box at the bottom of the window. After you select the panel endpoint pairs, they will be repositioned to the nearest boreholes.

Lithology, modeled stratigraphy, i-data, p-data, fracture, and aquifer fence panels can lie between boreholes - the slices can be placed anywhere within the model.

Straight stratigraphy fences must be drawn borehole to borehole, and the program will automatically snap panel endpoints to well locations.

Notes: Mistakes? Choose the **Edit** / **Undo** option to remove the last-picked panel. You can use this command repeatedly to remove panels in backward order. Or, choose **Edit** / **Reset** to clear the display and start over.

Fence diagram panels that extend beyond the current project dimensions will be truncated to the project boundaries. If you would like to be warned that this truncation has taken place, you can activate the Warn if Outside Project setting under the Options menu.

See also: Help / Contents / Borehole Manager/ Laying Out Vertical Sections and Fences for additional topics.

See also 2D Profile and Section Options, page 302.

Notes

Chapter 10 - Grid Model Tools

Grid Model Tools - Overview

Within the Borehole Manager you can create create grid models of stratigraphic surfaces using the Borehole Manager's **Stratigraphy** menu tools, and water level surfaces using the **Aquifer** menu tools. You can also perform "basic" gridding of XYZ data using the RockWorks Utilities **Map** / **Grid-Based Map** command. The program offers several gridding methods to do this interpolation of your data. Each operates differently, and each has strengths and differences. See "Gridding Methods", page 279.

The tools in the RockWorks Utilities **Grid** menu are used to summarize, manipulate, filter, and illustrate existing numeric grid models.

Computing Grid Statistics

The **Grid** menu's **Statistics** utility is used to get a general summary of the contents of an existing grid (GRD) file. The computations are reported as a:

- Textual ***report***, in which the summary of grid node values and computed statistics are displayed in a document in a text editor. Use this to confirm grid dimensions, view volumes, G value ranges and standard deviations.
- Plottable frequency ***histogram*** of the node values, reported as numbers or percent. This can be used to compare the G value distribution for models interpolated with different algorithms, and to look for anomalies.
- Plottable "***Krajewskigram***" or X,Y scattergram of original Z values (X-axis) versus computed node values (Y-axis). You can use this to gauge the accuracy of the grid model and view some error analysis.
- Computed grid ***residuals***, representing the difference between observed XY values and computed grid values at the same locations.
- New grid ***anomalies*** model, created in batch from multiple grid models, to highlight areas where multiple variables show anomalous tendencies.
- ***Standard deviations*** of grid node values. This can be helpful in isolating anomalous areas.
- In addition, grid nodes can be ***normalized*** for comparing different models with unlike Z value ranges.

Notes: For the residuals computations and Krejewskigrams, you'll also need the original XYZ data from which the grid model was computed.

Help / Contents / The RockWorks Utilities Datasheet / Grid Model Tools / Computing Grid Statistics.

Performing Arithmetic Operations with Grid Models

The tools in the **Grid** / **Math** menu are used to perform a variety of mathematical operations on an existing grid file, storing the results in a new grid file. The resulting model can be illustrated as a 2D map or 3D surface.

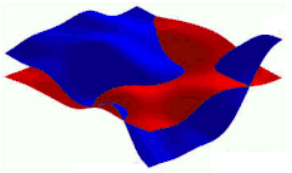
Grid & Grid: This tool performs arithmetical operations with the grid node Z-values in two existing grid files.
Grid & Constant: This tool performs arithmetical operations with the node Z-values in a single grid model and a constant, creating a new output grid model.
Density Conversion: Use this tool to multiply the grid cell volume (cell-width * cell-height * Z-value, thickness) by a constant (representing density per unit volume) to create a new "density" grid.
Absolute Value: Use this tool to convert the Z-values within an existing grid file to their absolute values, storing the new node values in a new grid file.
Resample: Use this tool to read an existing grid model and resample the nodes to the current project dimensions. Very handy if you need to make a grid model match another's extents and node spacing for filtering/math/comparison purposes.

Notes:

! In order for the program to match up corresponding nodes in the two input grid files in the Grid & Grid Math option, they must have the same dimensions (X and Y coordinates and range) and numbers of nodes. You can use the Grid / Statistics / Report option to see a dimension summary. During gridding, you can manually establish the grid dimensions and node spacing by activating the Confirm Model Dimensions check-box in the Model Dimensions window. You can resample an existing grid model to different dimensions using the Grid / Math / Resample option.
! For the Density Conversion tool, the Z-values of the input grid must represent thickness, and the thickness units must be the same as the X and Y coordinate units in order to compute a meaningful volume. You can use the tools in the Coords menu to translate X and Y coordinates to different units. You can use the RockWorks Edit / Columns / Thickness command to compute the thickness between two selected data sheet columns. The thickness values can then be gridded using the Map / Grid-Based Map option.

Help / Contents / RockWorks Utilities/ Grid Model Tools / Mathematical Tools.

Filtering Grid Models



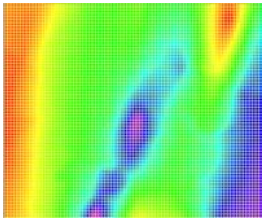
The tools in the **Grid** / **Filter** menu are used to read an existing grid file and alter the grid node Z values by imposing a filter of some kind. The resulting node values are stored in a new grid file. The resulting model can be illustrated as a 2D map or 3D surface.

The ***Boolean Filter*** transforms a real number grid file to a Boolean (true/false) file in which nodes are set to "1" if their Z-value falls within a user-specified range, and a "0" if the Z-values do not.
The ***Limit Filter*** is used to compare the nodes of one grid model with the corresponding nodes in another. Nodes whose Z values exceed or fall below those in the second grid can be re-assigned those node values. This is handy for constraining stratigraphy based on lower or upper layers.
The ***Minimum Area Filter*** is used to filter from Boolean or conventional grid models contiguous nodes whose areas fall below a threshold, setting them to zero, to eliminate exploration target areas that are too small.
The ***Polygon Clip Filter*** reads a user-created file listing polygon boundary coordinates, and sets a grid file's nodes that lie either inside or outside the polygon to a constant value or to the value of the corresponding node in another grid model.
The ***Range Filter*** deletes high or low Z-values from a grid file, reassigning them a user-specified constant.
The ***Rounding Filter*** reads Z-values stored in a grid file and rounds them up or down to the user-declared rounding interval.
The ***Smoothing Filter*** reads an existing grid file and averages the Z-values based on a user declared "filter" size. The smoother can be run 1 or more times, to get rid of spurious "noise" within the grid model and bring out regional trends.

Notes: The Polygon Vertices editor contains a button that will plot the polygon in a RockPlot2D window. If you save that image, it can then be plotted over your resulting map using RockPlot2D's **File** / **Append** command. See Polygon Vertices Tables (page 268) for more information.

See Help / Contents / RockWorks Utilities/ Grid Model Tools / Grid Filtering.

Editing Grid Models



The RockWorks Utilities **Grid** / **Edit** command is used to edit the node values stored in a RockWorks grid model, or to create from scratch a new grid with user declared dimensions and node values. This interactive editor color-contours node values, posts X,Y points if available, and allows editing of individual Z values or those within a polygon.

Notes: The Grid Editor is used to modify node "Z" values only. It cannot be used to modify the X,Y location coordinates of the nodes themselves. For moving grid nodes, see the Resample option in the Grid / Math menu.

See Help / Contents / RockWorks Utilities/ Grid Model Tools / The Grid Editor.

Performing a Slope/Aspect Analysis on Grid Models

The RockWorks Utilities **Grid** / **Slope/Aspect Analysis** is used to read an existing grid file and compute the changes in Z-values (e.g. elevations) between neighboring nodes, and store these in up to three new grid files:

A ***slope grid*** which contains the change (or slope) between node Z-values, expressed in degrees, percent, or radians. This shows the steepness of a structural face.
An ***aspect grid*** which contains the direction of the slope, expressed in azimuth degrees.
A ***second-derivative grid*** which contains the change in slope (the slope of the slope grid) to illustrate bends.

Notes:

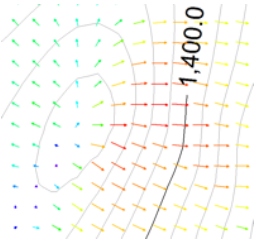
The grid files that result from the **Slope/Aspect Analysis** utility can be used to create a directional map (**Grid** / **Directional Maps**) such as upgradient or downgradient vector maps, flow maps, or strike and dip maps. These require both a slope (dip) grid and an aspect (direction) grid.

They can also be used to create a contour map (**Map** / **Grid-Based Map**) to illustrate selected slope angles (for example, areas where slope exceeds 10 degrees).

The map units (X,Y) must be the same as the Z (elevation) units in order for the slope computations to make sense.

Help / Contents / RockWorks Utilities/ Grid Model Tools / Directional Analysis.

Creating Directional Maps of Slope/Aspect Grid Models



The RockWorks Utilities **Grid** / **Directional Analysis** / **Directional Maps** option is used to illustrate slope and aspect grid models as a variety of 2-dimensional maps:

Downgradient vector maps display a small arrow at each node, pointing down-slope in the direction of the slope as modeled in the slope and aspect grid models. You may request that the arrows be scaled proportionally to the slope value.

Upgradient vector maps display a small arrow pointing up-slope at each node, with the option of the arrows scaled proportionally to the slope steepness.

Strike and dip maps display at each node a small line in the direction of the strike, with a smaller line perpendicular to this in the direction of the dip. Locations with zero dip angle are noted with closed circle symbols.

Flow maps illustrate the high-to-low pathway in the grid models using lines in a 2D map.

3D flow diagrams illustrate the high-to-low pathway in an existing surface model for display in 3D.

Notes: See also **Arrow Maps** in the **Linears** menu (page 187) for information about 2-dimensional maps with arrows that represent lineations.

Help / Contents / RockWorks Utilities/ Grid Model Tools / Directional Analysis.

Analyzing Movement of Slope Materials

The RockWorks Utilities **Grid / Directional Analysis** / **Movement Analysis** utility is used to determine the direction, inclination, distance, and velocity for X, Y, Z and time data (page 87).

Notes: Be sure that elevations, if used, are in the same units as the X and Y coordinates.

Help / Contents / RockWorks Utilities / Geotechnical Tools / Analyzing Movement of Slope Materials.

Performing a Trend Surface Analysis

Use the **Grid** / **Trend Surface Analysis** tools to determine regional trend for selected data in the main data sheet. This can help you to determine what trend order to select when creating a Trend Surface grid model, and it can help you to isolate regional anomalies by computing trend residuals. These tools are offered:

Use the **Trend Surface Analysis / Report** command to perform a trend surface analysis on a selected Z-value column in the data sheet and to list the correlation and residuals for first through sixth order polynomials in a report. The completed report is loaded into a RockWare text window. You may save the report text to disk, print the report, or copy its contents to the Clipboard for pasting into other applications.

Use the **Trend Surface Analysis / Residuals** command to perform a trend surface analysis on a selected z-value column and compute the residuals for a selected polynomial order, representing the difference between observed z-values and trend z-values. The residuals are stored in a data sheet column of the user's choice.

Notes: The trend surface report can be used to determine how well any of the trend surface models fit your data. The higher the correlation coefficient, the better the fit. This information can be helpful in determining whether there is much regional trend to your data. By isolating regional behavior, local anomalies can stand out.
This report can also be helpful if you are creating a trend surface map of your data, by providing correlation information. See Trend Surface Gridding in the Help messages for information about creating trend surface maps, and examples of different polynomials. Use the residuals to determine where localized differences from the regional background may be.

Help / Contents / RockWorks Utilities/ Grid Model Tools / Trend Surface Analysis.

Morphing Grid Models

The **Grid** /**Morph** command is used to generate a series of transitional grids / and/or contour-map images given two "end-member" grids. The user can specify the graphic format for the output maps, and they are then loaded into the RockWorks “picshow” application (page 203). This is a handy way to generate intermediate images between two models.

Help / Contents / RockWorks Utilities/ Grid Model Tools / Grid Morphing.

Importing Grid Models into RockWorks

The **Grid** / **Import Grid** command is used to read an existing set of gridded data stored in one of the accepted formats and translate the data into a RockWorks grid file format. This tool also imports JPG or BMP images and translates them into a grid format.

ASCII: ASCII grid files consist of a list of space-delimited xyz values in which each line contains one node, also referred to as "Text" format.

Bitmap: RockWorks can import BMP or JPG images and store them as grid models. Be sure the input file, declared at the top of the window, has a ".bmp" extension if it's a BMP file, and a ".jpg" extension if it's a JPG file.

Digital Elevation Model (DEM): RockWorks can import Canadian Government, USGS 30-Meter, or USGS 3 Arc Second DEM formats.

ESRI ASCIIGRID: Imports a grid model from an ESRI® GIS program that has been saved in an ASCII format.

GXF: This represents GXF (Grid eXchange Files) output from the Geosoft program. This program does not import "compressed" GXF grid models.

RockWorks7: Binary files that were created by the last DOS version of RockWorks.

Surfer: Import Surfer version 6 or version 7 and 8 ASCII or binary grid models.

Help / Contents / RockWorks Utilities/ Grid Model Tools / Grid Import & Export.

Exporting RockWorks Grid Models

Use **Grid** / **Export Grid** to export the data contained in a RockWorks grid model to another file format. It offers export to a variety of formats, with a variety of options:

ASCII XYZ: X and Y node locations and Z values are listed in three columns, with user-selected delimiter character, decimal precision, with or without a header.

ASCII Matrix: The Z-values only of the grid file are listed in rows and columns, with the

number of entries corresponding to the numbers of nodes horizontally and vertically in the grid file. The Z-values are listed at the decimal precision you select.

AutoCAD DXF Matrix: ASCII files which can be read into any software application that reads files in a DXF format. They will appear as a three-dimensional mesh surface.

Geosoft GXF: GXF (Grid eXchange) are an ASCII grid format read by Geosoft.

ESRI ASCIIGRID: Export the RockWorks grid to an ASCII grid file that's importable into ESRI GIS programs for contouring and other spatial analysis.

Ohio Automation ENZ: X and Y node locations and Z values are listed in three columns in an ASCII format, with columns separated by commas. The node order is the same as that listed for the ASCII XYZ, above.

RockWorks7: A grid file format read by the RockWorks version 7 program for DOS,.

RockWare RTM: The RockWare Terrain Model (RTM) is a binary grid file format originally designed as a method for shipping Digital Elevation Model (DEM) data.

Surfer: Choose from Surfer/6 binary or Surfer/7 and Surfer/8 ASCII and binary formats.

VistaPro: This is a binary grid format read by VistaPro, as DEM data.

Help / Contents / RockWorks Utilities/ Grid Model Tools / Grid Import & Export.

Importing LIDAR Data

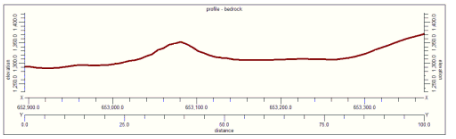
Use the **Grid** / **LIDAR XYZ -> Grid** tool to import XYZ files created from LIDAR (LIght Detection And Ranging) equipment and generate a grid model that represents the Z values (typically surface elevation).

This is different from the process of gridding external XYZ data in the **Map** / **Grid-Based Map** option in these ways:

- Because of the huge number of points in a typical LIDAR file, the program does not load the points into memory (it's 100% file based).
- There is no choice for gridding algorithm - each grid node is assigned the Z-value for the last LIDAR point in that cell.

Help / Contents / RockWorks Utilities / Grid Model Tools / Importing LIDAR Data.

Displaying Grid Model Profiles

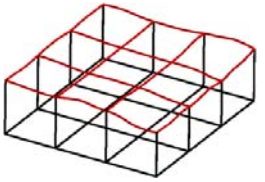


Use the **Grid** / **Grid -> Profile** tool to display the elevations in an existing grid model in a simple line profile drawing. The user can specify the position of the vertical slice within the grid area interactively or by specifying endpoint coordinates. User can specify line style and border options.

Notes: This profile tool is also available as the "Plot Surface Profile" setting within the Borehole Manager **Profile** and **Section** tools (**Striplogs**, **Lithology**, **I-Data**, **P-Data**, **Fractures**, **Aquifers** menus) in order to plot the ground surface as a line in these diagrams.

Help / Contents / RockWorks Utilities / Grid Model Tools / Grid Fences & Profiles.

Displaying Grid Model Fence Diagrams



Use the RockWorks Utilities **Grid** / **Grid -> Fence** tool to display the elevations in an existing grid model in a 3D line profile drawing. The user can specify the position of the vertical slices within the grid area interactively or by specifying endpoint coordinates. User can specify line style and border options. In the graphic example above, the grid fence is displayed in combination with a 3D surface representation of the input grid model.

Notes: This profile tool is also available as the "Plot Surface Profile" tool within the Borehole Manager **Fence** tools (**Lithology**, **I-Data**, **P-Data**, **Fractures**, **Aquifers** menus) in order to plot the ground surface as a trace in these diagrams.

Help / Contents / RockWorks Utilities / Grid Model Tools / Profile Tools.

See also: Page 132 and 133 for information about manually building stratigraphic fence diagrams and models.

Importing Stratigraphic Contacts from Grids into Stratigraphic Logs

Given a list of grid models, this program will define (or redefine) the contacts within existing stratigraphic logs based on the contents of a list of one or more stratigraphic surface models. Sample applications include: Interpolating elevations for missing contacts within borehole files (e.g. lost circulation intervals), estimating what a log might look like before the borehole is drilled (i.e. prediction).

Caveats: Items within the datasheet "Unit" column must already exist within the project's Stratigraphy Types Table. This program only works with vertical boreholes.

Help / Contents / RockWorks Utilities / Grid Model Tools / Grid Stratigraphic Tools.

Additional Grid Menu Tools

Grids -> Stratigraphic Fence: See page 132
Grids -> Stratigraphic Model: See page 133
Grids -> 3D Stack: See page 112
Grids -> Solid Model: See page 134

Chapter 11 – Solid Model Tools

Solid Menu Tools - Overview

The process of creating solid models is discussed in Chapter 8. Solid models are used to illustrate the 3-dimensional distribution of geochemistry, geophysical, lithology, or other measured values.

The tools in the RockWorks Utilities **Solid** menu discussed here are used to filter, extract, edit, and otherwise manipulate these solid models.

See also: Creating Solid Models (page 141), Solid Modeling Reference (page 285).

Computing Solid Model Statistics

The RockWorks Utilities **Solid** / **Statistics** utility is used to get a general summary of the contents of an existing solid model file. The statistical summary can be displayed in two ways:

- As a ***textual report***, in which the summary of node values and computed statistics are displayed in a document in a text editor. Example: Run this on two models to be sure they have the same dimensions for future mathematical operations.
- As a plottable ***frequency histogram*** of the node values, reported as numbers or percent. Be warned that histograms of high-density solid models may take a significant amount of time to create, or they may exceed the capacity of your computer system.
- As a plottable ***scatterplot*** of observed versus computed G values, representing model error. (We call these "Krajewskigrams" in honor of our associate who invented them.)
- As a listing of ***predicted versus modeled*** values in the data window.

Help / Contents / RockWorks Utilities/ Solid Model Tools / Solid Model Statistical Tools.

Performing Arithmetic Operations with Solid Models

The tools in the RockWorks Utilities **Solid** / **Math** option are used to perform arithmetic operations on the values stored in an existing solid model file, storing the results in a new solid model file. The following options are available:

Model & Model: This tool performs arithmetical operations with the node G-values in two existing solid model files.

Model & Constant: This tool performs arithmetical operations with the node G-values in a single solid model and a constant.

! In order for the program to match up corresponding nodes in the two input model, they must have the same dimensions (X, Y, and Z coordinates and range) and numbers of nodes. If you aren't sure of the "size" of any solid model, use the **Solid** / **Statistics** / **Report** option to obtain a summary. During modeling, you can manually establish the model dimensions and node spacing by activating the ***Confirm Model Dimensions*** check-box in the Model Dimensions window. If you need to change dimensions for either/both models you can use the Resample option, below.

Resample: This tool reads an existing solid model and creates a new model based on the current project dimensions. You can use this tool to resize models that are to be filtered against or run through mathematical operations with each other.

WARNING: This resampling process is very slow. You may find it easier to remodel the original data using the new dimensions.

Help / Contents / RockWorks Utilities/ Solid Model Tools / Mathematical Tools.

Filtering Solid Models

The RockWorks Utilities **Solid** / **Filter** option used to filter the nodes contained within an existing solid model file.

The ***Distance Filter*** is used to filter an existing solid model file based on the nodes' distances from the drill holes. All nodes that lie beyond the distance cutoff will be set to zero. This can be used to remove low-confidence areas from a model.

The ***Grid Filter*** is used to adjust the voxel values in a solid model based on their location above or below one reference grid model, or above, between, or below two reference grid models. This can be a handy way to assert stratigraphic surface or ground surface constraints on a solid model. Note that the input solid model and the input grid file *must have the same dimensions* and numbers of nodes in the X and Y directions in order for this filter to work. If you aren't sure, you can use the **Statistics** option in the **Grid** and **Solid** menus to view a summary of model dimensions and node spacings for grid and solid models, respectively.

The ***Polygon Filter*** reads a user-created file listing polygon boundary coordinates, and sets a solid model's nodes that lie either inside or outside a vertical projection of the polygon to a null value or a user-specified value.

The ***Range Filter*** deletes high or low G-values from a solid model file, reassigning them a user-specified constant.

The ***Rounding Filter*** reads G-values stored in a solid model file and rounds them up or down to the closest user-declared rounding interval.

The ***Smoothing Filter*** tool reads an existing solid model and averages the G-values based on a user declared "filter" size. The smoother can be run 1 or more times, to get rid of spurious "noise" within the model and bring out regional trends. Note that this tool pays

no attention whatsoever to the original data from which the model was generated and makes no effort to honor the observed data values.

The ***Tube Filter*** reads an existing solid model and, given a list of xyz coordinates that represent the axes of tubes (e.g. mine workings, tunnels, etc.), sets the nodes that are either outside or inside the tubes to a null value.

Help / Contents / RockWorks Utilities/ Solid Model Tools / Solid Model Filtering Tools.

Creating and Manipulating Boolean Solid Models

The RockWorks Utilities **Solid** / **Boolean Ops** menu contains tools to transform a real number solid model file to a Boolean (true/false) file in which nodes are set to "1" if their G-value falls within a user-specified range, and a "0" if the G-values do not. In addition, there are tools to manipulate the resulting Boolean models.

The following options are available:

Boolean Conversion: This tool transforms a real number solid model file to a Boolean (true/false) file. In this process, the G-values of nodes are set to "1" if their original G-value falls within a user-specified range, and to a "0" if the G-values do not fall within the range. (Then, multiply this model back against the original to zero-out areas where your criteria aren't met.)

Minimum Ore Zone Thickness: This tool is used to specify a minimum thickness for any individual ore or material zone to be included in the output model and computations. This is a means of discarding non-economic areas from the totals.

Minimum Total Ore Thickness: This tool is used to specify a minimum thickness for the combined, total ore or material zones to be included in the output model and computations. This is also a means of discarding non-economic areas from the totals.

Maximum Total Waste Thickness: This tool is used to remove small pockets of "non-ore" material from surrounding "ore" blocks, translating them to "ore" classification and including them in the output solid model for future calculations.

Stripping Ratio: This tool is used filter a Boolean solid model based on the ratio between the thickness of the overburden ("waste") and the thickness of the zone of interest ("ore"). Several methods of computing the stripping ratio are offered, based on individual ore zones or total ore zones.

Density Conversion: This tool is used to enter a multiplier for individual Boolean voxels so that the program can compute total mass as well as total volume. The X, Y, and Z-values of the input model must be in the same units in order to compute a meaningful volume

Notes: The tools listed after Boolean Conversion can read ONLY BOOLEAN SOLID MODELS.

The computations can be constrained by a grid model representing surface elevations.

Be sure the grid and solid models have the same XY dimensions and node spacings.

See also the **Solid** / **Convert** / **Ore Thickness to Grid** tool if you wish to convert the output Boolean model to a grid model for display as a 2D contour map.

Be sure that the conversion factor you enter for the Density Conversion tool matches the volume units that the program is using! If the program will be computing volume in cubic feet but your conversion constant represents weight per cubic inch, you would need to convert the constant to weight per cubic foot before entering it here.

Help / Contents / RockWorks Utilities/ Solid Model Tools / Boolean Model Tools.

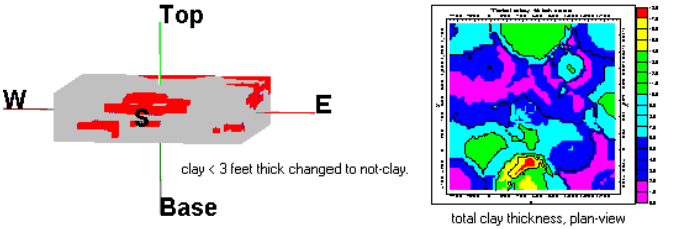
Converting and Extracting Solid Model Data

The RockWorks Utilities **Solid** / **Convert** menu contains tools to convert certain solid model data to 2-dimensional grid model format, to extract 2-dimensional "layers" from solid models as grid files, and to insert 2-D grid model layers into solid models. These tools are available:

Solid -> Grid: Given a solid model, this program will create a grid model in which the z-value represents either the highest, lowest, average, or sum of corresponding value within the solid model (i.e. all nodes which fall within the same vertical region).

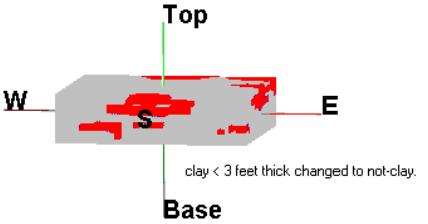
Ore Thickness to Grid: This tool translates a Boolean solid model file representing "ore" versus "not-ore" into a 2-dimensional grid file that represents total ore thickness, for display as a contour map, 3D surface, etc.

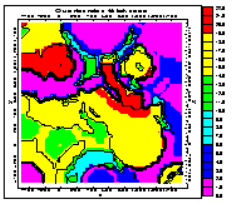
In this example, the solid model displays in dark clay zones that are > 3 feet thick (created in the **Solid / Boolean Ops / Minimum Ore Zone** Thickness tool). The contour map shows a plan view of the total clay thickness.



Overburden Thickness to Grid: This tool is used to translate a Boolean solid model file representing "ore" versus "not-ore" into a 2-dimensional grid file that represents total overburden ("not-ore") thickness. The resulting grid file can be illustrated as a contour map, 3D surface, etc.

In this example, the solid model displays in dark clay zones that are > 3 feet thick (created in the **Solid / Boolean Ops / Minimum Ore Zone** Thickness tool). The contour map shows a plan view of the total thickness of the NOT-CLAY or “overburden”.




total overburden thickness, plan view

Extract Grid from Model: This tool "pulls" out a 2-dimensional grid file from an existing real number or Boolean solid model file. The grid file can be extracted from any horizontal (constant Z) or vertical (constant Y or X) layer in the original solid model.

Insert Grid into Model: This tool is used to insert a 2-dimensional grid file "slice" into an existing real number or Boolean solid model file, replacing the existing node values with the grid's node values. The grid file can be inserted into any horizontal (constant Z) or vertical (constant Y or X) layer in the original solid model.

Notes:

The **Ore Thickness to Grid** and **Overburden Thickness to Grid** tools read ONLY BOOLEAN SOLID MODELS.

See Notes on Orientation in the Help messages for information on the coordinates that are represented in the Extract and Insert Grid tools.

See Editing Grid Models (page 167) for details about editing the extracted grid model. See Creating Grid-Based Maps (page 109) if you wish to illustrate the extracted grid file as a map.

Help / Contents / RockWorks Utilities/ Solid Model Tools / Converting, Extracting, Inserting Grid Models.

Editing Solid Model Slices

The RockWorks Utilities **Solid** / **Edit** command is used to edit the contents of a real number or Boolean solid model file, one "slice" at a time. The slice you specify will be loaded into the Grid Editor for viewing and editing. When your work in the Grid Editor is complete, the edited slice will be re-inserted into the solid model. The modified solid model is saved on disk under a different file name.

Notes: Because of the different orientations of the different slice planes, the X and Y axes of the 2-dimensional slice that is extracted from a solid model are not always going to coincide with the X and Y axes of the solid model. See Notes on Orientation in the Help messages for information. In addition, the solid model voxel G value will be displayed in the Editor as the Z value.

Help / Contents / RockWorks Utilities/ Solid Model Tools

Morphing Solid Models

The RockWorks Utilities **Solid** / **Morph** tool is used to read a list of existing solid model files (*.MOD) and create a dynamic "movie" within RockPlot3D that shows time-based changes within these models. You can specify any number of intermediate, transitional models be generated between the existing models.

Notes: Be sure the solid model files have the same dimensions and number of nodes to morph successfully.

Help / Contents / RockWorks Utilities/ Solid Model Tools

Initializing a Blank Solid Model

Use the **Solid** / **Initialize** tool to create a new solid model from scratch, at the dimensions and node spacing you declare. All model nodes will be initialized to a single, user-declared value.

Help / Contents / RockWorks Utilities/ Solid Model Tools

Importing Solid Models

The **Solid** / **Import** command is used to read an existing set of regularly-spaced XYZG data stored in an ASCII format and translate the data into a RockWorks solid model file format.

Notes: See the Solid Model Import Format in the Help messages for details about the input file's required structure.

Help / Contents / RockWorks Utilities/ Solid Model Tools

Exporting Solid Models

Use the **Solid** / **Export** command to export the data contained in a solid model file created within RockWorks. It offers model export to these different formats, with a variety of options:

ASCII XYZG: XYZ node locations and G values are listed in four columns, separated by the character of your choice, at the decimal precision you select, with or without a header.

NOeSYS (T3D): Exports XYZG data from the model to a NOeSYS ASCII format. RockWorks permits you to launch T3D automatically when the file export is completed.

Slicer Dicer: Exports XYZG data from the model to a Slicer Dicer format.

Notes: See the help messages for details about the output file structure.

Chapter 12 - Computing Volumes

Volume Tools - Overview

RockWorks offers a number of tools for computing volumes of stockpiles, of formations, and of specific material zones in solid models.

The RockWorks Utilities **EZ Volume** tool reads X, Y, and thickness values from the datasheet and computes volume using a Delaunay triangulation method. The output is a textual report. This is often used to compute stockpile volume.

The RockWorks Utilities **2D (Grid Model)** tool computes the volume of a stratigraphic unit based on a grid generated from XY and thickness values, among other parameters.

The RockWorks Utilities **Grade -> GT (Grade Thickness)** - given a solid model that contains grade values, this tool will produce a grade-thickness grid and contour map in which the contours represent the grade multiplied by the thickness.

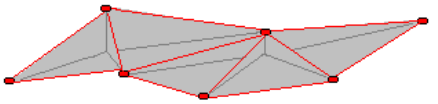
The RockWorks Utilities **Extract Solid** reads an existing solid model (such as soil chemistry or lithology type), determines the **volume of a pit** that would be required to extract the portions of the solid model that fall within a specified range (e.g. contaminated soil or a selected lithotype). The output is a report that lists the pit and contaminant volumes and the stripping ratios, a 2D diagram illustrating the pit elevations, and/or a 3D diagram showing the filtered solid and the pit elevations.

The Borehole Manager's **Stratigraphy Volumetrics** tool computes volumes of **stratigraphic layers** at elevation intervals, displaying a report in the RockWorks Utilities datasheet, using either grid-based or solid-based stratigraphic models. This is an easy method for computing volumes of **stratified material**.

The Borehole Manager's **Lithology Volumetrics** tool computes volumes of **lithology zones** at elevation intervals, displaying a report in the RockWorks Utilities datasheet. This is an easy method for computing volumes of **non-stratified** material.

The Borehole Manager's **I-Data Volumetrics** tool performs a variety of filtering operations on an existing solid model to create a **detailed report and diagram** of **material volume** (or mass). Filters include overburden (stripping ratio), zone thickness, polygon boundaries, distances from boreholes. This can be used in both **mining** (marketable-material volumes) and **remediation** (contaminated soil volumes).

RockWorks Utilities: EZ Volume of X, Y, Thickness Data



The RockWorks Utilities **Volumetrics** / **EZ Volume** calculator is used to compute the volume for a column of thickness values in the RockWorks Utilities datasheet and list the

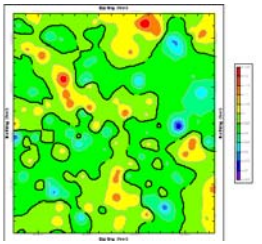
volume in a textual report. It uses a basic approach: Volumes are computed using a Delaunay triangulation method in which the samples are connected together in a network of triangles, a sample at each vertex. The volume of each triangle is computed, based on the thicknesses used as Z-values, and then the total volume added up.

This method tends to provide lower estimates of total volume than an orthogonal grid-based calculation. Optional volume-to-mass conversion is available.

Datasheet: RockWorks Utilities. This tool reads XYZ files where the Z value represents thickness. (See page 78.)

Help / Contents / RockWorks Utilities/ Volume Tools / Computing Volumes based on Thickness Values.

RockWorks Utilities: Advanced Volume Computation of X, Y, Thickness Data



The RockWorks Utilities **Volumetrics** / **2D (Grid Model)** option is used to compute formation volume, given a column of thickness values in the spreadsheet, with a variety of filtering parameters. The computations are grid-based, with the gridding algorithm user-selected.

Some of the advanced filtering operations include thickness, stripping ratio, up to 5 quantitative data column range restrictions, polygon areas, and distance.

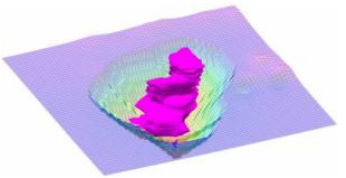
Finally, you have the options of:

- Storing the final thickness (or mass) model as a grid file on disk, and
- Displaying the volumetric (or mass) computations in a text report, and/or
- Displaying the final thickness (or mass) grid model as a 2-dimensional line or color-filled contour map, or labeled cell map, and/or
- Displaying the final thickness (or mass) grid model as a 3-dimensional profile or raised line or color-filled contour map.

Datasheet: RockWorks Utilities. This tool reads XYZ files where the Z value represents thickness. (See page 78.)

Help / Contents / RockWorks Utilities/ Volume Tools

RockWorks Utilities: Extracting Solids



The RockWorks Utilities **Volume** / **Extract Solid** tool reads an existing solid model (such as soil chemistry or lithology type), determines the volume of a pit that would be required to extract the portions of the solid model that fall within a specified range (e.g.

contaminated soil or a selected lithotype). The output is a report that lists the pit and contaminant volumes and the stripping ratios, a 2D diagram illustrating the pit elevations, and/or a 3D diagram showing the filtered solid and the pit elevations.

This program assumes you have already created a solid model that illustrates the distribution of the desired material. This can be created using the RockWorks Utilities **Solid** / **Model** tool (for XYZG data in the datasheet or external file) or using the Borehole Manager Model tools (**Lithology**, **Stratigraphy**, **I-Data**, **P-Data** menus). You may also input solid models that have already been filtered for G value range or with a polygon filter (**Solid** / **Boolean Ops** or **Solid** / **Filter** tools).

The program also requires that you have an existing grid model of the surface elevations for the project. This will create more accurate computations and surface models.

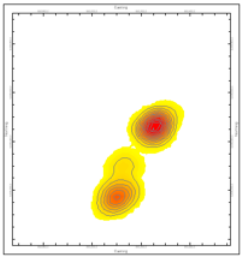
Notes:

This extraction process offers some options regarding maximum slope, and whether benches are desired and maximum bench height.

Use the Report Captions settings to fully customize your report to your units. See the help messages for examples.

Help / Contents / RockWorks Utilities/ Volume Tools / Extracting Solids.

RockWorks Utilities: Computing Grade Thickness



The RockWorks Utilities **Volumetrics** / **Grade -> GT (Grade Thickness)** tool reads an existing solid model that contains grade values (e.g. percent eU308) this program will produce a GT (grade-thickness) grid and contour map in which the contours represent the grade multiplied by the thickness. In other words, high valued areas may represent either thick zones of lower-grade ore or thin zones of high-grade ore. The output includes a grid model and a 2D contour map or 3D surface map.

Help / Contents / RockWorks Utilities/ Volume Tools.

Borehole Manager: Creating a Lithologic Volume Report

Use the Borehole Manager's **Lithology** / **Volumetrics** tool to read an existing lithologic solid model and compute volume, mass, number of nodes, and/or percent of each rock or soil type at user-declared elevation levels. Lithology solid models can be created in the **Lithology** / **Profile**, **Section**, **Fence**, **Surface Map**, **Plan Map** and/or **Model** options.

Notes: If you select the Mass option, these computations are based on the Density Factors declared in the current Lithology Table which declare mass per cubic unit.

Help / Contents / Borehole Manager/ Lithology Tools / Computing Lithology Volumes.

Borehole Manager: Creating a Stratigraphic Volume Report

Use the Borehole Manager's **Stratigraphy** / **Volumetrics** tool to read a saved stratigraphic model and compute volume, mass, number of nodes, and/or percent of each stratigraphic type in each user-defined elevation layer. Stratigraphic solid models (.MOD) can be saved when you create a block diagram using the **Stratigraphy** / **Model** tool.

Notes: If you select the Mass option, these computations are based on the Density Factors declared in the current Stratigraphy Types Table which declare mass per cubic unit.

Help / Contents / Borehole Manager/ Stratigraphy Tools / Stratigraphy Volumes.

Borehole Manager: Creating Detailed Geochemistry Volume Reports and Diagrams

The Borehole Manager's **I-Data** / **Volumetrics** tool is designed to perform a variety of "what-if" filtering operations and volume computing operations on an existing solid model. The input model can represent precious metal assays, contaminant concentrations, or any measurable component for which you wish to compute volume.

This volume calculator specializes in models that are not stratified or homogeneous. You can filter the solid model for interbed thickness, material zone thickness, polygon areas, and distance from a borehole.

Output windows:

The final, filtered Boolean solid model file that represents the distribution of favorable materials can be displayed in RockPlot3D.

The final thickness or mass grid model can be displayed in RockPlot2D or 3D.

The detailed or summarized text report is displayed in a text window.

See also: RockPlot3D for display of solid model or stratigraphy volume right in the 3D window. The Solid / Statistics / Report tool for a quick report of dimensions and volume of any solid model.

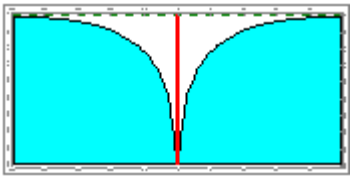
Help / Contents / Borehole Manager/ I-Data Tools / Creating Detailed I-Data Volume Reports and Diagrams.

Chapter 13 – Hydrology/Hydrochemistry Tools

The RockWorks Utilities **Hydrology** and **Hydrochemistry** menus contain tools used for computing water level drawdown, creating water level and precipitation graphs, and hydrochemistry diagrams and calculations.

In earlier versions of RockWorks, these tools were lumped under the "Hydro" menu.

Computing Drawdown for a Single Well

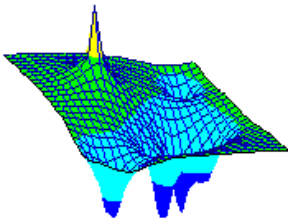


The RockWorks Utilities **Hydrology** / **Drawdown (1 Well)** utility is used to calculate water-level drawdown for a single well using the Theis non-equilibrium equation. Data for a single well is entered directly into the program dialog box; it is not read from the program datasheet.

Notes: See the help messages for a listing of the Theis equation.

Help / Contents / RockWorks Utilities / Hydrology Tools / Computing Drawdown for a Single Well.

Computing a Drawdown Surface

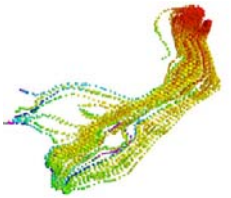


The RockWorks Utilities **Hydrology** / **Drawdown Surface** utility is used to read a listing of drawdown data parameters from the datasheet and generate a potentiometric surface model based on pumping and/or injection wells using the Theis non-equilibrium equation.

Notes: See the help messages for a listing of the Theis equation.

Help / Contents / RockWorks Utilities / Hydrology Tools / Computing a Drawdown Surface.

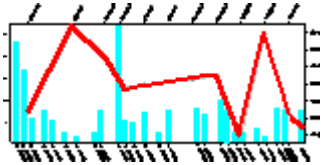
Plotting 3D Flowlines



The RockWorks Utilities **Hydrology** / **Flowlines** command reads a particle path data file (as can be imported from ModPath data) and plots ModPath-style particle paths as 3-dimensional tubes.

Help / Contents / RockWorks Utilities / Hydrology Tools / Plotting Particle Paths as 3D Flowlines.

Plotting Water Level versus Precipitation



The RockWorks Utilities **Hydrology** / **Hydrograph** command reads from the main datasheet listings of water level and precipitation measurements over time, and creates a HydroGraph diagram that illustrates their relationship.

Help / Contents / RockWorks Utilities / Hydrology Tools / Creating Hydrographs.

Computing Ion Balance

The RockWorks Utilities **Hydrochemistry** / **Ion Balance** tool is used to read a listing of ion concentrations from the datasheet and compute cation:anion ratio for each sample, in milli-equivalents per liter. RockWorks uses the following equation for the ion balance:

((cations - anions) / (cations + anions)) x 100

You may choose up to 4 additional cations and 4 additional anions in the computations.

Help / Contents / RockWorks Utilities / Hydrochemistry Tools / Computing Ion Balance.

Creating Piper Diagrams

The RockWorks Utilities **Hydrochemistry** / **Piper** command is used to read a listing of ion concentrations from the datasheet and create a Piper diagram for groundwater ion concentration analysis.

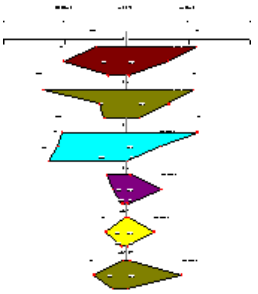
Piper diagrams consist of three parts: Two trilinear diagrams along the bottom and one diamond-shaped diagram in the middle. The trilinear diagrams illustrate the relative concentrations of cations (left diagram) and anions (right diagram) in each sample. Each sample will be represented by a point in each trilinear diagram; unique symbols may be selected for each sample and can be referenced in a symbol index at the top of the diagram. Symbols may be accompanied by labels if desired. The diamond field is designed to show both anion and cation groups.

Circles may be plotted around each point to illustrate total dissolved solids ("TDS") for the sample. The total dissolved solid computation will include all components listed in the data file ("standard" ions and additional ions).

Concentrations entered in the source data file in units of milligrams per liter are converted to milli-equivalents per liter for display on the diagram. You may choose up to 4 additional cations and up to 4 additional anions for the TDS computations.

Help / Contents / RockWorks Utilities / Hydrochemistry Tools / Creating Piper Diagrams.

Creating Stiff Diagrams



The RockWorks Utilities **Hydrochemistry** / **Stiff** command is used to read a listing of ion concentrations from the datasheet and create a Stiff diagram for groundwater ion concentration analysis.

Stiff diagrams plot milli-equivalent concentrations of cations on the left side of the diagram and of anions on the right. Each ion is plotted as a point, and the points are connected to form a polygonal shape. The ions are plotted in a consistent order (Na+K across from Cl; Ca across from HCO3 + CO3; Mg across from SO4) so that each polygon becomes that sample's "signature". Additional ions, if present, are plotted in the order that they are listed, below the standard ions.

Notes:

You may choose up to 4 additional cations and up to 4 additional anions for display in the Stiff polygons.

Use the Vertical Point Spacing and Polygons Per Page settings to control lengths of polygons. Use the Horizontal Scaling setting to determine widths of polygons; if you choose Automatic and there are multiple pages, be warned that each page may represent a different horizontal scale.

Help / Contents / RockWorks Utilities / Hydrochemistry Tools / Creating Stiff Diagrams.

Creating Stiff Diagram Maps

The RockWorks Utilities **Hydrochemistry** / **Stiff Map** option is used to create a map with a Stiff diagram illustrating ion concentrations at each sample point. See page 106 for more information.

Computing Total Dissolved Solids

The RockWorks Utilities **Hydrochemistry** / **Total Dissolved Solids** command is used to read a listing of ion concentrations from the datasheet and compute total dissolved solids for each sample.

Total dissolved solids represent the sum of all "declared" ions, as listed in the Data Input Columns, in the parts per million (or milligrams per liter) units read from the RockWorks Utilities datasheet.

Notes: You may choose up to 4 additional cations and up to 4 additional anions in the computations.

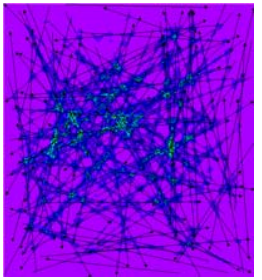
Help / Contents / RockWorks Utilities / Hydrochemistry Tools / Computing Total Dissolved Solids.

Notes

Chapter 14 - Directional Statistics Tools

The RockWorks Utilities **Linears** and **Planes** menus contains tools used for performing analyses on and creating diagrams of directional (2D or 3D) data. These tools were previously lumped under the "Dirstat" menu.

Creating Arrow Maps

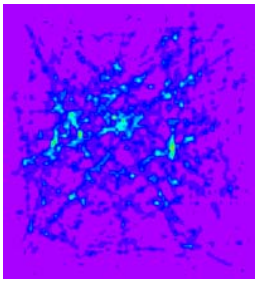


The RockWorks Utilities **Linears** / **Arrow Map** tool is used to read X1Y1X2Y2 data (page 86) and create a map in which lineations are represented with arrows plotted from the beginning X,Y coordinates to the ending coordinate pair. This graphic example illustrates an arrow map overlaying a lineation density contour map, discussed next.

Notes: See Digitizing data for information about digitizing line endpoint data directly into the data sheet. See Creating Lineation Maps (below) for maps without arrowheads..

Help / Contents / RockWorks Utilities / Linear Feature Tools / Creating Arrow Maps.

Gridding and Mapping Lineation Frequencies, Lengths, and Intersections

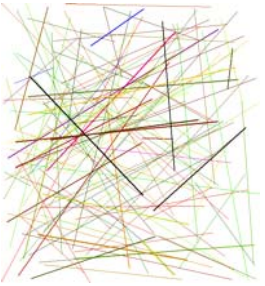


The RockWorks Utilities **Linears** / **Lineation Gridding** menu command is designed to read lineation data (in X1, Y1, X2, Y2 endpoint coordinate format), and create a grid file that models the lineation frequency, cumulative lengths, and/or intersections, with a variety of weighting options.

Notes: See Digitizing Data for information about digitizing line endpoint coordinates directly into the data sheet. See Creating Lineation Maps (below) for mapping the lineations themselves.

Help / Contents / RockWorks Utilities / Linear Feature Tools / Gridding and Mapping Lineation Frequencies, Lengths, and Intersections.

Creating Lineation Maps



The RockWorks Utilities **Linears** / **Lineation Map** utility is used to create a map of lineations from X1Y1X2Y2 line endpoint data (page 86).

Notes: See Digitizing Data for information about digitizing line endpoint coordinates directly into the data sheet. See Creating Arrow Maps (earlier topic) for information about creating maps in which the lineations contain arrowheads.

Help / Contents / RockWorks Utilities / Linear Feature Tools / Creating Lineation Maps.

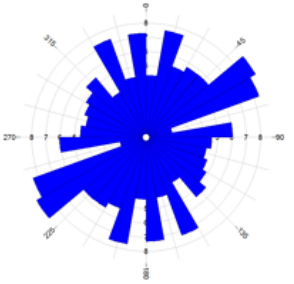
Computing Lineation Bearing, Length, and Midpoint

The RockWorks Utilities **Linears** / **Lineation Properties** command is used to compute the bearing, length, and/or midpoint of lineations listed in the main datasheet as X1 Y1 X2 Y2 line endpoint coordinates (page 86).

Notes: See Digitizing Data for information about digitizing endpoint data directly into the datasheet.

Help / Contents / RockWorks Utilities / Linear Feature Tools / Computing Lineation Length, Bearing, and Midpoint.

Creating Rose Diagrams



The RockWorks Utilities **Linears** / **Rose Diagram** / **From Bearings** and **From Endpoints** utilities read either bearing data (page 84) or line endpoint data (page 86) and generate a directional diagram that depicts the orientations of the linear features. Full or half-rose diagrams are available. Line endpoint data can be interpreted as directional (1-direction) or oriented (2-directions).

Help / Contents / RockWorks Utilities / Linear Feature Tools / Creating Rose Diagrams.

See also: Creating Rose Diagrams and Rose Diagram Maps from downhole fracture data (page 155)

Importing DXF Lineations into the Datasheet

The RockWorks Utilities **Linears** / **Import** / **DXF Lineations** utility is used to import lineation endpoint data from a DXF file, storing the endpoint coordinates in the main RockWorks data sheet.

Notes: "LINE" and "POLYLINE" entities only are read from the DXF file. "POLYLINE" entities will be broken down into their individual segments. See also Importing Files into RockPlot2D (page 211) for information about importing DXF images into the plotting window.

Help / Contents / RockWorks Utilities / Linear Feature Tools / Importing DXF Lineations into the RockWorks Datasheet.

Computing the Orientation of a Single Plane Based on Three Points

The RockWorks Utilities **Planes** / **3-Points -> Planes** / **One Set** tool is used to compute strike and dip based on three points and plot a surface as a contour map. The X,Y,Z points are typed into the program window (they are not read from the datasheet).

Help / Contents / RockWorks Utilities / Planar Feature Tools / Computing the Orientation of a Single Plane based on Three Points.

Computing Plane Orientations Based on Three Points

Given a list of xyz coordinates for three points along a series of planes, the **Planes** / **3-Point -> Planes** / **Multiple Sets** program computes the dip direction (or strike) and dip angle for planes that pass through these points. The output is stored within two new datasheet columns.

Datasheet: RockWorks Utilities, multiple sets of X1Y1Z1 X2Y2Z2 X3Y3Z3 data points.

Help / Contents / RockWorks Utilities / Planar Feature Tools / Computing Plane Orientations bassed on Three Points.

Computing Planar Intersections

The RockWorks Utilities **Planes** / **Beta Intersections** command reads a listing of planar orientations from the RockWorks data sheet (page 84) and calculate the lineations resulting from the intersections of *all* of the planes in the file. The linear values will be stored in an ASCII text file that can be displayed in the RockWorks text editor when completed.

The number of intersections that will be computed is:

number = n (n - 1) / 2 where n is the number of individual planes in the input file.

As the number of original planes increases, the number of resulting lineations increases dramatically. For example, a data set with 20 planes will result in 190 lineations, and 200 planes will produce 19,900 lineations!

Notes: A comparison: Beta Intersections reads a listing of individual planar strike and dip measurements from the data sheet and calculates the lineations that result from the intersection of each plane with each other plane in the data set. This can result in a tremendous number of computed lineations! Beta Pairs, on the other hand, reads strike and dip measurements for pairs of planes, and for each pair computes the single resulting lineation.

Help / Contents / RockWorks Utilities / Planar Feature Tools / Computing the Intersections of Planes.

Computing Planar Intersections - Planar Pairs

The RockWorks Utilities **Planes** / **Beta Pairs** tool is used to read the strike and dip of pairs of planes (page 87) and calculate the lineations resulting from their intersections. The bearing and plunge of these lineations are stored in new columns in the datasheet.

Notes: A comparison: Beta Intersections (previous) reads a listing of individual planar strike and dip measurements from the data sheet and calculates the lineations that result from the intersection of each plane with each other plane in the data set. This can result in a tremendous number of computed lineations! Beta Pairs, on the other hand, reads strike and dip measurements for pairs of planes, and for each pair computes the single resulting lineation.

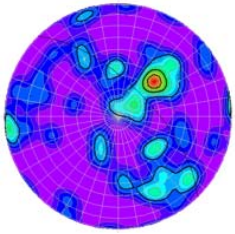
Help / Contents / RockWorks Utilities / Planar Features Tools / Computing the Intersections between Pairs of Planes.

Rotating 3D Data

Use the RockWorks Utilities **Planes** / **Rotate Planes** command to rotate 3D features (planes or 3D lineations) by a specified amount, and to list the resulting strike and dip (or dip direction, dip angle) values in two new columns of your data sheet. The input data can be entered using the right-hand rule or as dip direction, dip angle.

Help / Contents / RockWorks Utilities / Planar Feature Tools / Rotating Planes about a Line.

Creating Stereonet Diagrams



The RockWorks Utilities **Planes** / **Stereonet** utility reads planar, linear, or rake data from the data sheet (page 84), and displays the orientation of these features on a stereonet diagram using points and great circles. Optional gridding is available to display point density with line or color-filled contours.

Notes: Data can be listed as right-hand rule or dip direction. Equal area and Equal angle projections are available. Gridding can be using the Step Function or Spherical Gaussian methods. See the help messages for details about the stereonet statistics and more.

Help / Contents / RockWorks Utilities / Planar Feature Tools / Creating Stereonets.

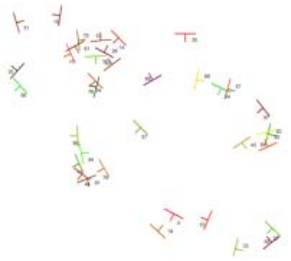
See also: Creating Stereonets and Stereonet Maps from downhole fracture data (page 155).

Converting Strike Bearing to Dip Direction

The RockWorks Utilities **Planes** / **Strike -> Dip Direction** command is used to read from the datasheet a listing of azimuth bearings representing strike and translate them to dip direction. The output values will be stored in a designated column in the same datasheet. This permits you to change the format of your data from "right hand rule" to "dip direction."

Help / Contents / RockWorks Utilities / Planar Feature Tools / Converting Strikes to Dip Direction.

Creating Strike and Dip Maps



The RockWorks Utilities **Planes** / **Strike & Dip Map** utility is used to plot a strike and dip map based on X and Y coordinates, strike, dip, and color data from the data sheet (page 84).

Notes: See also directional maps of slope/aspect grid models (page 168).

Help / Contents / RockWorks Utilities / Planar Feature Tools / Creating a Strike and Dip Map.

Converting Polylines to Planes

The **Planes** / **Import** / **Polylines -> Planes** program reads xyz polyline coordinates from an external ASCII file and computes the orientations of planes that pass through the polyline vertices. It is designed for applications in which the user has xyz coordinates that represent the intersections between fractures or contacts and surface topography. By computing the orientations of planes that pass through these points, it is possible to analyze and/or visualize the relative positions and orientations of these structures.

Help / Contents / RockWorks Utilities / Planar Feature Tools / Converting Polylines to Planes.

Translating Coordinates – Converting Azimuth <-> Quadrant

The RockWorks Utilities **Coords** menu contains two tools for translating decimal-style azimuth bearings (i.e. 135) into quadrant-style bearings (i.e. S45E), and vice versa. The input data is read from the datasheet (strike and dip data, page 84) and the output coordinates are recorded there.

Help / Contents / RockWorks Utilities / Coordinate Conversion Tools / Converting Azimuth Data to Quadrant Format, Converting Quadrant Data to Azimuth Format.

Chapter 15 - Statistical Tools

Statistical Tools - Overview

The RockWorks Utilities **Stats** menu includes program for computing univariate, bivariate, and trivariate statistics as well as for creating a variety of statistical diagrams. Some of these tools are also available in the Borehole Manager for summarizing database records.

Computing Univariate Statistics – RockWorks Utilities

The RockWorks Utilities **Stats** / **Univariate** tool is used to calculate statistics for a single column of samples in the current datasheet. Data may be filtered out when an appropriate filter range is selected. Statistics include simple summaries (population, min, max, range, mean, etc.) as well as Mean + - 1, 2, 3, and 4 Standard Deviations.

Notes: This option is also available as a right-click option - simply right-click anywhere within a RockWorks Utilities datasheet, choose **Columns** / **Statistics** and you will see the statistical report in a text window.

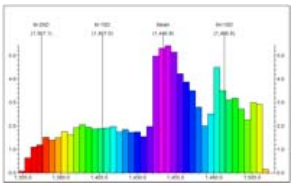
Help / Contents / RockWorks Utilities / Statistical Tools / Creating a Statistical Report for a Column of Values.

Computing Univariate Statistics – Borehole Manager

The Borehole Manager's **I-Data** / **Stats** and **P-Data** / **Stats** tools are used to calculate statistics for a single track of samples in the current database. Spatial and G-value filters are available, as is resampling. Statistics include simple summaries (population, min, max, range, mean, etc.) as well as Mean + - 1, 2, 3, and 4 Standard Deviations.

Help / Contents / Borehole Manager / I-Data Tools or P-Data Tools

Creating Frequency Histogram Plots – RockWorks Utilities



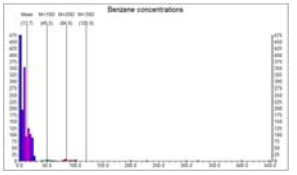
The RockWorks Utilities **Stats** / **Histogram** tool is used to read a single column of data from the datasheet and determine the frequency or percentage of the total number of measurements for that variable that falls in each user-defined grouping or "cell." These values are represented as a bar histogram plot.

It also contains a tool for creating multiple histogram plots of separate data columns and combining them into a single image.

Notes: The Multiple Histogram tool is a handy way to see quickly the distribution of numerous variables.

Help / Contents / RockWorks Utilities / Statistical Tools / Creating a Frequency Histogram for a Column of Values, Creating Multiple Frequency Histograms for Two or More Columns of Values. .

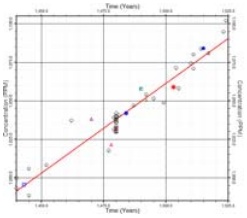
Creating Frequency Histogram Plots – Borehole Manager



The Borehole Manager **I-Data** / **Histogram** and **P-Data** / **Histogram** options are used to read a single track of data from the database and determine the frequency or percentage of the total number of measurements for that variable that falls in each user-defined grouping or "cell." These values are represented as a bar histogram plot.

Help / Contents / Borehole Manager / I-Data Tools or P-Data Tools

Creating a Scattergram (X, Y) Plot for Two Variables

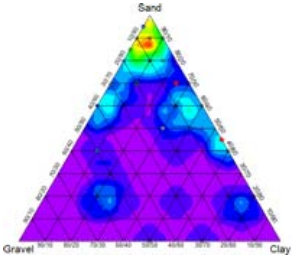


The RockWorks Utilities **Stats** / **Scattergram** tool is used to plot the data listed within a designated column in the datasheet against the data within another column.

Notes: Linear Regression and Polynomial Fit are available for interpolation.

Help / Contents / RockWorks Utilities / Statistical Tools / Creating a Scattergram (X,Y) Plot for two Variables.

Creating a Ternary Diagram for Three Variables



The RockWorks Utilities **Stats** / **Ternary** tool is used to generate a trilinear diagram based on three columns of data. Optional contouring is available to show point density.

In addition, the Ternary program also includes options for plotting a variety of classification systems. These will plot a pre-defined diagram in the background with your data points and/or contours in the foreground. The currently available templates include Folk's (1954) siliclastic classification system, Schlee's (1973 - after Shepard) siliclastic classification system, Shepard's 1954 siliclastic classification system, and the USDA soil classification system.

Help / Contents / RockWorks Utilities / Statistical Tools / Creating Ternary (Tri-lateral) Diagrams.

Normalizing Data

The **Stats** / **Normalize** utility is used to read a single column of values from a RockWorks data sheet and normalize the data values so that they range between two user-specified values. The resulting data are listed in a new data sheet column.

Help / Contents / RockWorks Utilities / Statistical Tools / Normalizing Data.

Standardizing Data

The RockWorks Utilities **Stats** / **Standardize** utility is used to read a single column of values from a RockWorks data sheet and to calculate the mean and the deviation of each sample value relative to the mean. The resulting data are stored in a new column in the data sheet. Once computed, display the standardized values as a contour map to show anomalous areas

Help / Contents / RockWorks Utilities / Statistical Tools / Standardizing Data.

Generating Random Numbers

The RockWorks Utilities **Stats** / **Random** utility is used to generate random numbers within a specified range or from a normal distribution. This utility can generate both positive and negative numbers with or without decimal values.

Help / Contents / RockWorks Utilities / Statistical Tools / Generating Random Numbers.

Computing Point to Point Distances

The RockWorks Utilities **Stats** / **Point Distances** utility is used to read X,Y or X,Y,Z point locations from the datasheet and compute a variety of statistics regarding the distribution of the points.

Help / Contents / RockWorks Utilities / Statistical Tools / Computing Point to Point Distances.

Notes

Chapter 16 - Survey Tools

Survey Menu - Overview

The **Survey** option in the **Map** menu contains a variety of tools designed to translate different kinds of survey data:

Converting Bearing / Distance Data and Creating Maps

The RockWorks Utilities **Survey** / **Bearing/Distance** tools are used to convert survey data (page 81) to XYZ coordinates for display in a new datasheet, and/or to create a plottable map in 2D or 3D that illustrates the survey stations and/or transect lines with a variety of labeling options. The survey data must list one or more control points, and bearing, distance, and inclination to the survey stations.

Help / Contents / RockWorks Utilities / Survey Tools / Converting Survey Data to XYZ, Plotting 2D Survey Maps, Plotting 3D Survey Maps.

Converting Triangulation Data to XYZ

The RockWorks Utilities **Survey** / **Triangulation** tool is used to convert triangulation survey data (page 81) to XYZ coordinates for display in the current datasheet. This program requires that two or more stations have known X,Y, Z (elevation) coordinates from which other coordinates can be computed.

Help / Contents / RockWorks Utilities / Survey Tools / Converting Triangulation Data to XYZ Coordinates.

Setting Up X,Y Stations

The RockWorks Utilities **Survey** / **Setup XY Stations** tool is used to create a new set of X,Y coordinates based on a single user-entered coordinate, a known grid-based station arrangement, and a user-entered spacing.

Help / Contents / RockWorks Utilities / Survey Tools / Setting Up X,Y Stations.

Interpolating Points Along a Line

The **Survey** / **Interpolate Points Along a Line** tool is used to create a new set of X,Y coordinates based on beginning and ending coordinates of a line, and the point spacing along that line.

Help / Contents / RockWorks Utilities / Survey Tools / Interpolating Points Along a Line.

Computing Downhole Survey Coordinates

The **Survey** / **Drill Hole Survey** tool is used to read depths, bearings, and inclinations from a downhole survey table, and compute XYZ coordinates at user-specified intervals down the borehole. It also offers a 2D and 3D diagram view of the deviated borehole.

Help / Contents / RockWorks Utilities / Survey Tools / Computing Downhole Survey Coordinates.

Chapter 17 –Accessory Image Tools

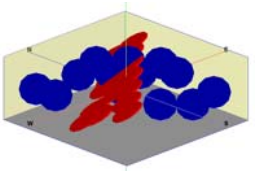
3D Images

The RockPlot3D plotting window, part of RockWorks, is used for display of surfaces, solids, fences, and other 3-dimensional images created in many Borehole Manager and RockWorks Utilities tools discussed in earlier chapters.

The **Grafix** menu (available from both the Borehole Manager and the RockWorks Utilities) contains additional tools for creating general-purpose 3D images which can be appended to other 3D images right within RockPlot3D (**File** / **Append**).

Help / Contents / Graphics Tools / 3D Utilities.

3D Discs

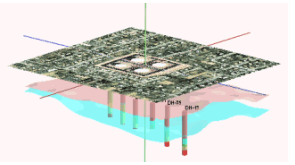


The Discs program plots 3D discs based on xyz coordinates, dip-direction, and dip amount, read from the datasheet (page 91). It is designed to display the relative orientations of planes in three-dimensions.

3D Bitmaps

Use the **Grafix** / **3D Utilities** / **Images** tools to apply 3-dimensional characteristics to bitmap images. This includes floating a bitmap horizontally at a specified elevation, draping an image over a surface, or displaying images as horizontal or vertical panels. A variety of bitmap images are supported: BMP, JPG, PNG, TIFF, AFI, VST, TGA, PCC, PCX, and ICO. In addition, EMF and WMF metafiles are supported.

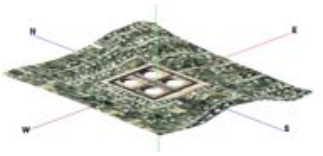
Float a bitmap at a particular elevation



The **Grafix** / **3D Utilities** / **Images** / **Float** tool reads an existing bitmap image and, given input user coordinates and an elevation, generates a flat, floating 3D image of the bitmap.

Notes: Be sure the X and Y coordinates you assign to the bitmap corners are in the same units as those in the project with which you'll be combining this image. Once the image is created, use RockPlot3D's **File** / **Save As** to save the floating bitmap view, then use **File** / **Append** to append an existing RockPlot3D view to this image.

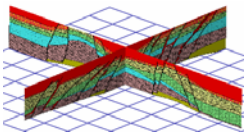
Drape a bitmap over a surface



the **Grafix** / **3D Utilities** / **Images** / **Drape** tool reads an existing bitmap image and, given an existing grid model, generates a 3D image of the bitmap that confirms with the grid surface.

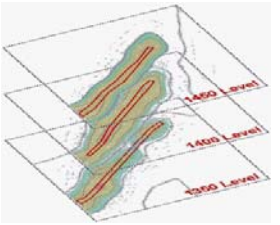
Notes: Use RockPlot3D's **File** / **Save As** to save the draped bitmap view, then use **File** / **Append** to append an existing RockPlot3D view to this image.

Display bitmap images as vertical panels



The **Grafix** / **3D Utilities** / **Images** / **Panels** / **Vertical** tool reads a list of bitmap images and their coordinates, and displays them as vertical image panels.

Display bitmap images as horizontal panels

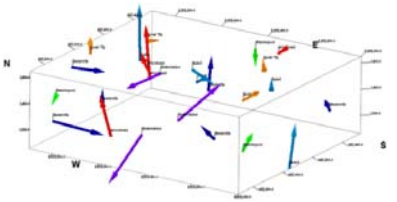


The **Grafix** / **3D Utilities** / **Images** / **Panels** / **Horizontal** tool read a list of bitmap images and their coordinates, and displays them as horizontal or inclined image panels.

Display Bitmaps on a 3-Dimensional Cube

The **Grafix** / **3D Utilities** / **Images** / **Cubes** program reads a list of images from the RockWorks Utilities datasheet and display them on a 3 dimensional cube for display in RockPlot3D. These can be used to create displays of building in 3D.

3D Oriented Objects



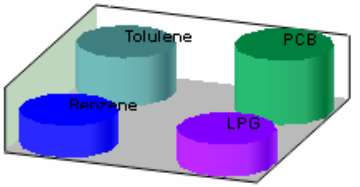
The **Grafix** / **3D Utilities** / **Oriented Objects** tool reads location, bearing, inclination, and length information from the datasheet and draws 3-dimensional arrows at those locations for display in RockPlot3D. Use this to display fossils, archeological items, flow vectors or other oriented items in 3D space.

3D Perimeter

The **Grafix** / **3D Utilities** / **Perimeter** option reads X and Y coordinate listings from the datasheet and plots fence-like perimeter edges for subsequent inclusion within other three-dimensional diagrams. During building of the perimeter "fence" you can specify its base and top elevation.

Notes: Use RockPlot3D's **File** / **Save As** to save the image, then use **File** / **Append** to append an existing RockPlot3D view to this image.

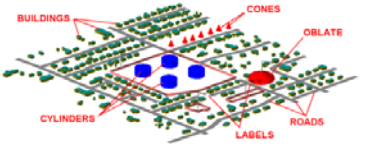
3D Storage Tanks



Grafix / **3D Utilities** / **Storage Tanks** / **Horizontal** and **Grafix** / **3D Utilities** / **Storage Tanks** / **Vertical** tools read location, elevation, radius and color data from the datasheet (page 90) and draws 3-dimensional cylindrical tanks at those locations for display in RockPlot3D. Use this to display underground or surface tanks with your 3d images. The tanks can be oriented vertically or horizontally.

Notes: Use RockPlot3D's **File** / **Save As** to save the tank image, then use **File** / **Append** to append an existing RockPlot3D view to this image.

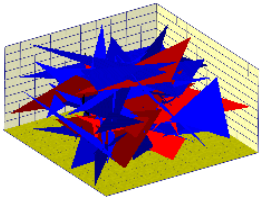
3D Surface Objects



The **Grafix** / **3D Utilities** / **Surface Objects** tool is used to create simple 3D entities such as buildings, roads, cylinders, and walls that may be plotted along with other 3D diagrams in order to show relative positions of surface items. Data is read from an external ASCII file.

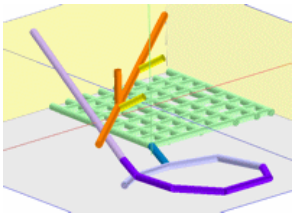
Notes: Use RockPlot3D's **File** / **Save As** to save the image of the surface items, then use **File** / **Append** to append an existing RockPlot3D view to this image.

3D Triangles



The **Triangles** program is used to plot a series of colored triangles in 3D space. The input consists of a datasheet that lists the coordinates for each triangle vertex.

3D Tubes



The **Grafix** / **3D Utilities** / **Tubes** option reads X1Y1Z1 X2Y2Z2 locations from the datasheet (page 91) and draws 3D tubes between these locations for display in RockPlot3D. Use this to display pipes, mine workings, structural diagrams in 3D space.

Other Tools

The **Grafix** menu's **3D Utilities** also offers a stand-alone reference cage tool that's the same as the cage options listed within many of the program menus. (See 3D Diagram settings, page 302.)

It also contains a stand-alone append-XML tool that functions just like the Append tool in RockPlot3D. (See page 226.)

2D Utilities

The **Grafix** menu's **2D Utilities** tools are stand-alone duplicates of those that exist within RockPlot2D:

Append: Combines two RK6 files.

Append Raster Image: Inserts a raster image into a RK6 file.

Clip: Clips a RK6 file within a rectangular region.

Montage: Combines multiple 2D images into a montage.

Import: Offers tools for importing AGL, DXF, and ESRI Shapefiles into RockPlot2D. (See also page 211.)

Export: Offers tools for exporting an existing RK6 file to a WMF, EMF, BMP, JPG, PNG, TIFF, or RockPlot3D format.

Help / Contents / Graphics Tools / 2D Utilities.

Other Tools

Help / Contents / Graphics Tools / Misc Image Tools .

Creating an Animated GIF Image

The **Grafix** / **Images** / **Animated GIF** option is used to create an animated GIF file (suitable for inclusion within web pages) based on a list of images, such as the list generated by the Grid / Morph program.

Appending RK6 Files and Raster Images

The **Grafix** / **Images** / **Append Raster Image** option is used to combine an existing RK6 file (from Rockplot2D) with a raster image that you georeference. The raster image can lie on top of or underneath the RK6 file's entities. The resulting image is saved under a new RK6 file name.

Screen Digitizing from a Raster Image

The **Grafix** / **Images** / **Digitize From Bitmap** program is used to import a bitmap (JPEG or BMP), calibrate it to global coordinates, and digitize points, lines, polylines, and polygons. As the items are selected, the global coordinates are stored within an editable data window along the right side of the screen. This data may then be copied into other applications.

See also: Digitizing data with an electronic digitizing tablet (page 98).

Help / Contents / Graphics Tools / Misc Image Tools / Digitizing Data from Bitmaps.

Displaying a RockWorks PicShow

The **Grafix** / **Images** / **PicShow** option is used to read a list of names of bitmap images (BMP or JPG format) from the RockWorks Utilities data sheet, and display them in order, with an adjustable delay between frames. The PicShow can run once or be continually looped to repeat the display list.

Raster to RockPlot2D

The **Grafix** / **Images** / **Raster -> RockPlot2D** tool can be used to add aerial photos to your maps or raster well logs or core pictures to your strip logs, cross sections and fence diagrams. This procedure supports BMP, JPEG, TIFF, WMF, EMF, PNG, TGA, and PCX formats. For very large images you may want to resize them to save disk space and for better viewing quality using the new Raster Conversion utility, below.

Raster Conversion

The **Grafix** / **Images** / **Raster Conversion** tool is used to read bitmap images and resize and/or sharpen them. This would typically be done prior to displaying the images in RockPlot2D. This procedure supports BMP, JPEG, TIFF, WMF, EMF, PNG, TGA, and PCX formats.

Rectifying Image

The **Grafix** / **Images** / **Rectify Image** tool reads a bitmap image and allows you to calibrate it to real world coordinates, rotate it to N-S and E-W orientation, clip it to project or user-defined coordinates, and display it in RockPlot2D or floating/draped in RockPlot3D. Extra large images can be resampled to lower resolution.

Notes

Chapter 18 - Widgets

The Widgets menu contains a variety of miscellaneous geology, financial, graphic, and reference tools. These were previously contained in the "Geo-Tools" tab along the left edge of the program window.

Area/Volume Calculator

The **Widgets** / **Area/Volume** tools are used to perform geometric calculations such as surface areas, volumes, and side lengths of various geometric shapes and solids.

Color Numbers

The **Widgets** / **Colors** tools are used to generate integer color numbers for use within RockWorks.

Color Numbers: Displays the color numbers for any color you select from a palette.

RGB -> Windows: Displays the integer color numbe for a known RGB color you enter.

Financial Utilities

The **Widgets** / **Financial Utilities** tools are used to calculate cost and profit breakdown, lease analysis, and amortization on loans by changing various factors within the utility equations.

The **Break-even Analysis** program is used to determine when a project has paid for itself. The program may also be used to estimate profits and losses.

The **Lease Analysis** program calculates square footage rates, monthly rent, and annual rent based on any combination of the other variables.

The **Loan Analysis** (amortization) program is used to determine various loan-related items such as when a loan will be paid off, the total amount paid at the end of the loan period, and so on.

Geological Time Chart

The **Geological Time Chart** option in the Widgets menu is an interactive program designed to show the duration, ages, and major events of various geological time periods.

Igneous Rock Identification

The **Widgets** / **Igneous** option starts an interactive program used to identify igneous rocks by displaying a series of questions about the rock characteristics, and offering a classification based on your responses.

Periodic Table

The **Periodic Table** option inside the Widgets menu is used to retrieve information about various elements by pointing at the elemental symbol on the table and pressing the mouse button.

Trigonometry Calculator

The **Widgets** / **Trigonometry Calculator** tool is used to perform various trigonometric calculations, such as apparent dip or true dip, drilled thickness, strike and dip from 3 points, and more.

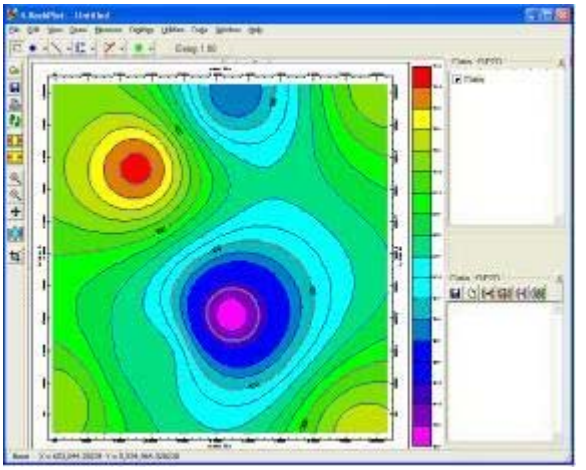
Unit Converter

The**Unit Converter** option inside the Widgets menu is used to convert measurement units (length, area, pressure, velocity, etc.) By entering a single value in a particular measurement system, you can create a table displaying an equal measurement in other units.

The program reads the conversion data from a text file named "unitconv.tab." This file lists in blocks the different measurement types, and within each block the unit values for 1 "standard" unit.

Chapter 19 – Displaying 2D Images - RockPlot2D

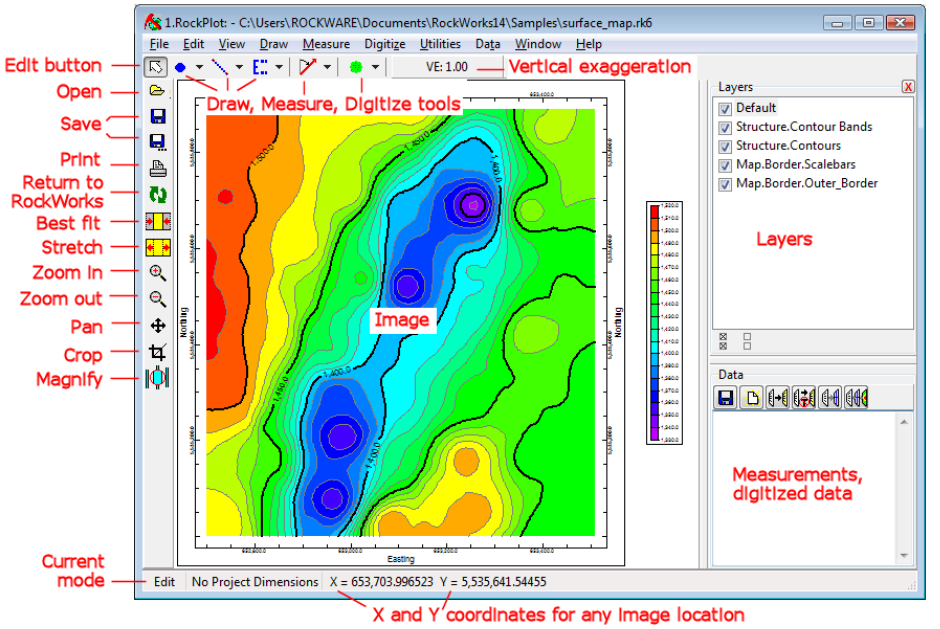
RockPlot2D Overview



RockPlot2D is one of the plotting engines for RockWorks. It is used to display 2-dimensional maps and diagrams as they are being created, and for opening saved images at a later date. RockPlot2D contains its own set of menu and toolbar commands, which are discussed in this section.

See also: RockPlot3D (page 225) for information about manipulating images in the RockWorks 3D plotting window, and ReportWorks (page 241) for information about the new page layout tool in RockWorks.

Quick Summary of RockPlot2D Tools



Toolbar Summaries

Left-hand toolbar: File operations (Open, Save, Print), view operations (best fit, stretch, zoom, pan, magnify), and crop.

Upper toolbar: Edit-mode, draw points (circles, symbols, text), draw lines (lines, polylines, rectangles, polygons), draw miscellaneous (scale bars, text tables, lithology & stratigraphy & color legends, images, grids), measure tools (bearing, distance, perimeter, area), digitize tools (vertices, lines, polylines, polygons), vertical exaggeration.

Data toolbar: Save, clear, copy all text, copy only numeric text, append to image, create new image.

Menu Summaries

File menu: Open, save, print, append RK6 files, open a new ReportWorks window, set RockPlot2D options, import files, export files, close RockPlot2D, close RockWorks.

Edit menu: Undo, copy image, cut/copy/paste/delete individual items.

View menu: Stretch, best fit, zoom in, zoom out, vertical exaggeration, set diagram extents, make all objects visible.

Draw menu: Draw circles, symbols, text, lines, polylines, rectangles, polygons, scale bars, text tables, legends (lithology, stratigraphy, well construction, color), new layer.

Measure menu: Bearing, distance, perimeter, area.

Digitize menu: Vertex (point), line, polyline, polygon.

Utilities menu: Annotate with border, rescale, clip image, coordinate conversion.

Data menu: Save contents of data pane, clear data, copy all/part of data, display data contents as graphic in new window or as overlay with current graphic.

Window menu: Tile RockPlot2D windows, access other Rockplot2D windows or main program.

Managing RockPlot2D Files

This section discusses the process of opening and saving "RK6" files that are displayed in the RockPlot2D window.

Help / Contents / RockPlot2D / Managing RockPlot2D Files.

Creating a New RockPlot2D Window

A new RockPlot2D window is created automatically any time that a 2-dimensional map or diagram is created within RockWorks. Multiple RockPlot2D windows may remain open at any time.

If you are working in RockWorks and wish to open an existing map or diagram that has already been saved as a “RK6” file (RockWorks2006 and newer) or “RKW” file (RockWorks2004, 2002, or 99), you'll need to access a RockPlot2D window first. You can launch RockPlot2D by selecting the File / RockPlot2D menu option, or by clicking on the **RockPlot2D** toolbar button (if displayed). Use Tools / General Preferences to turn on the toolbar buttons.

Opening a RockPlot2D Plot File (RK6)

Use RockPlot2D's Open-file toolbar button or **File** menu / **Open** command to open an existing 2-D RockWorks graphic file, such as a map, cross section, or rose diagram, that has been saved as an “RK6” file in RockWorks2006 or 14.

You can also use the Project Manager window to open graphic files: just double-click on the name of an RK6 file to open it. (See page 71.)

If you need to open an older “RKW” file created in RockWorks2004, RockWorks2002, or "recent" versions of RockWorks99, choose RKW in the Files of Type prompt.

If you are opening an RKW file from versions older than RockWorks2006, you will be warned, "This file needs to be updated to the current format. Do you want to convert?" If you choose ***Yes***, the program will allow you to type in a new name for the updated file.

If there is no RockPlot2D window yet displayed on the screen, you will need to create a new RockPlot2D window first (previous topic).

Saving RockPlot2D Files

Use the **File** / **Save** and **File** / **Save As** commands to save the current image under its existing name or under a new file name.

RockPlot2D always stores plot files in its own "RK6" format. If you need to export the image to a different graphic format, you can use the Export command.

Combining 2D Plot Files

The RockPlot2D **File** / **Append** command is used to add the contents of a RockPlot2D file (*.RK6) onto the end of a diagram displayed on the screen, thereby combining the two. This is a handy way to combine, for example, project contours with a reference base map. In order to preserve the existing plot file, the combined image will be loaded into a new RockPlot2D window.

Be sure that the two maps or diagrams must occupy the same coordinates in space in order for them to overlay correctly. You can use the coordinate display in the RockPlot2D toolbar to get an idea of the coordinate range of any diagram. Just move the mouse pointer around the RockPlot2D window and note the change in the coordinate listing. You can use the RockPlot2D **Utilities** / **Rescale** command to rescale a map to a different coordinate range. You can use the **Utilities** / **Degrees to UTM** or **UTM to Degrees** commands to convert between decimal longitude / latitude and UTM coordinates.

See also: The Montage tool for information about rescaling and combining plots. The ReportWorks program (page 241) for laying out pages with RK6 images.

See Help / Contents / RockPlot2D / Managing RockPlot2D Files / Appending RockPlot2D Images.

Printing RockPlot2D Files

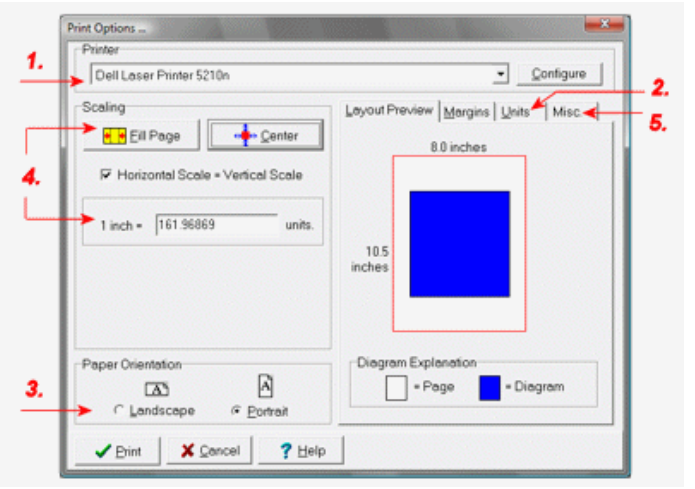
Use the RockPlot2D **File** / **Print Setup** and **File** / **Print** commands to output the map or diagram to your printer.

You should use the **Print Setup** command first to establish the type of printer you are using, and the paper size and orientation.

> **!** See your Windows documentation for information about installing printer drivers, and see your printer's documentation regarding specific printer settings.

The **Print** command is used to send the graphic image to the printer.

When you select this command, you'll see a large Printer Scaling Options window.



1. Set up your printer: Choose a printer from the drop-down list, and configure the printer settings (paper size, etc.) using the Configure button.
2. Select your print units: Choose from diagram units per inch, centimeters, feet, or meters.
3. Select your paper orientation: Landscape or Portrait. You should see the Layout Preview update accordingly.
4. Set the diagram scaling: First, decide if the horizontal scale needs to equal the vertical scale. Then decide whether you need a specifi scale or if it's ok just to fill the page. You can use the Center button to center the diagram on the paper.
5. Set the margins and pattern scaling (optional).

Help / Contents / RockPlot2D / Managing RockPlot2D Files / Printing RockPlot2D Images.

Importing Files into RockPlot2D

Use the RockPlot2D File / Import tool to display other kinds of graphic files within RockPlot2D, save them in a RK6 format, combine them with existing RK6 maps, etc. These imports include

AGL files
DLG files
DXF files
ArcInfo E00 files
ESRI Shapefiles
Raster images (BMP, JPG, PNG, TIFF, TGA, EMF WMF)

See Help / Contents / RockPlot2D / Managing RockPlot2D Files / Importing Images.

Exporting RockPlot2D Files

The Rockplot2D File / Export command is used to save its 2D images in a graphic format other than its own “RK6” format. The following exports are offered:

Bitmap (BMP) format
JPEG format
KMZ (Google Earth)
PNG format
TIFF format
DXF format
WMF format
EMF format
RockPlot3D

Help / Contents / RockPlot2D / Managing RockPlot2D Files / Exporting RockPlot2D Images

Viewing RockPlot2D Files

RockPlot2D is the plotting engine for "flat" or 2-dimensional maps and diagrams within RockWorks, and these maps and diagrams are plotted automatically into a RockPlot2D window on the screen upon their completion.

Once the image is plotted on the screen, you may do any of the operations discussed in the topics below.

Help / Contents / RockPlot2D / Viewing Plot Files.

Resizing the RockPlot2D window

Use these options to resize a RockPlot2D window:

To fill the screen with the image window, click on the Windows Maximize button in the upper-right corner of the window.

To make a maximized window smaller, click on the Windows Restore Down button.

To adjust a window size by hand, position the cursor on a window boundary or corner. When you see the cursor change shape to a double-sided arrow (<->), click and hold the left mouse button, and drag the boundary to the desired location.

Once a window is resized, the image within it will be redrawn within the new available space.

Changing the screen scaling of the image

To adjust the display of an image in the plot window, select one of the scaling options:

Best Fit - The **Best Fit** command (**View** menu) or toolbar button will fill the window as best it can with the current diagram while maintaining the currently-established vertical exaggeration.

Stretch - The **Stretch** toolbar button or **View** menu command is used to fill the current window with the diagram, regardless of the horizontal and vertical scaling used. The represented vertical exaggeration will be displayed in the **VE** item in the toolbar.

VE: You can use the **Vertical Exaggeration** button in the toolbar (and in the **View** menu) to stretch or compress the vertical axis of the screen image by a specific factor. To make the image taller, enter a value > 1. To make the image flatter, enter a value < 1.

See also: Printing RockPlot2D files (page 210) regarding print scaling.

Setting the Map or Diagram Extents

Use the **View** / **Set Diagram Extents** menu option to change the coordinate extents of the map or diagram displayed in the RockPlot2D window.

The West, North, East, and South prompts display the current edge coordinates in the RockPlot2D map or diagram. To change the coordinates, you have several options:

- You can type in new coordinates these to increase or decrease the extents along any axis.
- ***Additional Margins (%)***: Use these settings to increase the image extents by a specific percent along all axes or individual axes. Once established, you must then click on the Scan Extents button (below) to scan the current coordinates and then add the requested margins.
- ***Scan Extents***: Click this button to scan the current map or diagram to reset the extents. The extents will be set to the minimum and maximum coordinates of the objects in the image, plus any margin percent established.
- ***Project Dimensions***: Click this button to reset the extents to those listed in the current project dimensions.

Zooming in and out of the screen image

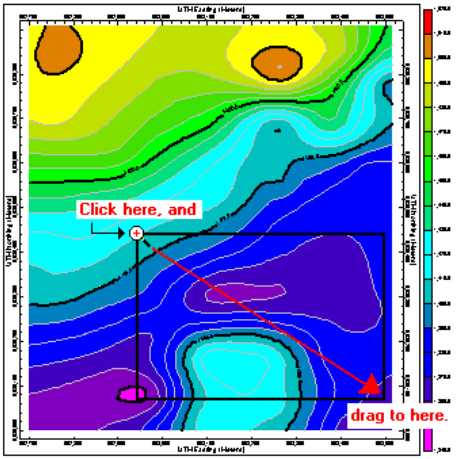
Follow these steps to enlarge/reduce the image display in the RockPlot2D window. (See also the Magnifier in the next topic.)

1. Use the **Zoom In** toolbar button or menu command to enlarge a portion of the map or

diagram plotted within RockPlot2D.

Select the **Zoom In** button or command.

Position the magnifying glass tool at one corner of the area to be enlarged. Depress the mouse button and drag the tool to the opposite corner.



Release the mouse button when you have reached the opposite corner of the area to be enlarged. When you release the mouse button, the program will redraw the selected area on the screen, maintaining the current vertical exaggeration.

2. Use the **Zoom Out** toolbar button or **View** menu command to restore the active RockPlot2D window to its original scaling.

Simply click once on the **Zoom Out** tool to re-plot the active plot file at its original scaling.

The original diagram scaling is restored even if you "zoomed in" several times. Equal vs. non-equal x- and y-scaling will be preserved.

Using the RockPlot2D Magnifier

Use the Magnifier button (or type Ctrl+M) to magnify selected portions of the current screen display. Simply click on the button and a square or rectangular zoom-area will be visible somewhere within the plot.

Use your mouse to drag the zoom area around the window. Right-click on the zoom area to select the magnification amount. You can also resize the zoom area by grabbing and dragging a border or corner with your mouse. To disable the magnifier, click the Magnifier button again (or type Ctrl+M).

Using the Pan tool to shift the current view

Use the Pan button to shift your view of the current plot file if it's being viewed in a "zoomed in" state.

1. Simply click the Pan button, place your cursor within the image, and left-click, holding the mouse down. You'll see cross hairs at the cursor location.
2. Drag the image in the direction where it is to be repositioned, and release the mouse button.
3. Repeat this process as necessary.
4. To terminate Pan mode, click any other toolbar button

Making all RockPlot2D Objects Visible

All 2D graphic items can be rendered invisible in two different ways:

- By accessing its Attributes window and removing the check in its Visible check-box (see Editing Graphics)
- By making the layer in which the item resides invisible (see Working with Layers)
- Select the View / Make All Objects Visible option to make all individual objects and all layers visible.

Returning to the main RockWorks data window

RockWorks allows multiple RockPlot2D windows to remain open at the same time. Because of this, it's quite easy to find your computer display full of windows. To access the main RockWorks data window, follow these steps:

Click on the **Return to Data Window** button to move the plot window to the background and display the data window.

Or, if the RockPlot2D window is small enough to see the RockWorks window in the background, simply click on the RockWorks window. This will move the plot window to the background, and move the data window to the top.

Accessing an already-open RockPlot2D window

RockWorks allows multiple RockPlot2D windows to be open simultaneously. As you click back and forth between data and plot windows, it can become difficult to keep house and locate buried images. To locate and bring to the front a specific plot window, follow these steps:

1. Click on the **Window** menu in any RockWorks or RockPlot2D window, and you will see listed there all currently-open RockPlot2D windows. Click on the name of the

RockPlot2D window you wish to access. Or,

2. Look for the RockPlot2D icon in the Windows taskbar (the file's name will be displayed if you point to the icon with your mouse) and click on it to bring it to the front.

Any plot window that has not yet been saved will be shown as Untitled.

Editing Tools

Editing RockPlot2D Graphics

RockWorks-generated graphic images that are displayed in the RockPlot2D window contains graphic objects that can be selected, moved, resized, and edited.

To select a RockPlot2D graphic item:

1. Click the Edit button in the upper toolbar.
2. Select an item using either of these methods:
   - Item-Clicking: Position the cursor on the item to be grabbed and click on it to select it. The selected item will be displayed with handles on each corner. The cursor will change shape to a pointer. You can select additional items by holding down the Shift key as you click on them. All selected items will appear with selection handles.
   - Selection Rectangle: Position the cursor in the graphic window and click and drag a rectangular "rubber-band" area, within which all items will be grabbed.

To move a RockPlot2D graphic item:

1. Select the graphic item as described above.
2. To move the item, simply click on it with your mouse, and drag it to its new location. You can also use your keyboard's arrow keys to move items in the specified directions.

To resize a RockPlot2D graphic item:

1. Select the graphic item as described above.
2. Position the cursor onto one of the item's handles, and watch for the cursor to change shape to or . Click and drag the handle outward / inward to make the item larger / smaller. (You can also resize an item via its Attributes window, below.)

To edit a RockPlot2D graphic item:

1. Select the graphic item as described above.

2. Right-click on the item, and choose Properties from the pop-up menu. The program will display the item's Attributes window. (You can also simply double-click on the item to access the Attributes window.)
3. Edit the attributes as you want (see details below), and click the OK button to apply the changes and close the window.

See Help / Contents / RockPlot2D / Editing Tools for information about the graphic item Attributes windows:

Circle Attributes
Symbol Attributes
Text Attributes
Line Attributes
Polyline Attributes
Rectangle Attributes
Polyfill (polygon) Attributes
Scalebar Attributes
Text table Attributes
Pattern Legend Attributes (lithology, stratigraphy, and well construction)
Color legend Attributes
Raster image Attributes
Grid Attributes

Working with RockPlot2D Layers

RockPlot2D allows you to organize the different items on a page into different "layers". These are groups of items that can be displayed or hidden with the click of a button.

Opening RockPlot2D generates a single layer, named "Default Layer." Subsequent items that are drawn or inserted into the page are done so in that layer, until a new layer is created.

When RockWorks generates a map or diagram, there may be different layers created for the different image components, such as map contours, border annotation, and legends.

To add a layer to the current document, choose the **Draw** / **New Layer** menu item or right-click in the Layers pane (upper-right side of the window) and choose **Add**. The program will add a new layer entry into the layer pane, named New Layer. Be sure to highlight a particular layer prior to adding zitems to your document; items are always added to the currently-highlighted layer. (See also "Moving Items," below.)

To select a layer to be active, click on its name in the Layers pane. It will be displayed as highlighted. Subsequent items that you add to your document will be added to that layer.

To rename a layer, right-click on the layer's name in the Layers pane along the right side of the window, and choose **Edit**. Edit/type in a new name. This can help you to be more specific with layer items, such as "company legend items" rather than "New Layer2".

To move an item to a different layer, right on the item, and choose **Change Layer** from the pop-up menu. In the displayed window, choose the layer from the drop-down list, and click OK. Note that subsequent access of the item's Attributes settings will display the new layer name.

To move multiple items to a different layer, select all of those items (so that all are displayed with handles), right-click, and choose **Change Layer**. In the displayed window, select from the drop-down list the layer name to which the items are to be associated. Subsequent access of the items' Attributes windows will display the new layer name.

To copy one or more items to another layer, left click on the item(s), choose **Edit** / **Copy** (or type in Ctrl + C). Then click on the layer name to which the item(s) are to be pasted, in the Layers pane of the window, and select **Edit** / **Paste** (or type in Ctrl + V). The item(s) will be inserted into the document again, and associated with the specified layer.

To display a layer's items, insert a check-mark in the layer's check-box. To hide a layer's items from the display, remove the check-mark from the layer's name.

Undoing RockPlot2D Changes

Use the RockPlot2D **Edit** / **Undo** command - or type the keyboard shortcut of Ctrl+Z - to cancel or undo the last insertion or editing operation made to the current RockPlot2D graphic image. RockPlot allows up to 5 Undo operations sequentially, as established in the **File** / **Options** menu.

RockPlot2D Drawing Tools

Use the tools in the RockPlot2D **Draw** menu to add symbols, text, shapes, images, legends, and grids to the current image.

See Help / Contents / RockPlot2D / Drawing Tools for step-by-step instructions about inserting the following items into a RockPlot2D image:

Drawing Circles (**Draw** / **Point Types** / **Circles**)
Drawing Symbols (**Draw** / **Point Types** / **Symbols**)
Inserting Text (**Draw** / **Point Types** / **Text**)
Drawing Lines (**Draw** / **Line Types** / **Lines**)
Drawing Polylines (**Draw** / **Line Types** / **Polylines**)
Drawing Rectangles (**Draw** / **Line Types** / **Rectangles**)
Drawing Polygons (**Draw** / **Line Types** / **Polygons**)

Inserting Scalebars (**Draw** / **Insert** / **Scalebar**)
Inserting Text Tables (**Draw** / **Insert** / **Text Table**)
Inserting a Lithology Legend (**Draw** / **Insert** / **Lithology Legend**)
Inserting a Stratigraphy Legend (**Draw** / **Insert** / **Stratigraphy Legend**)
Inserting a Well Construction Legend (**Draw** / **Insert** / **Well Construction Legend**)
Inserting Color Legends (**Draw** / **Insert** / **Color Legend**)
Inserting Images (**Draw** / **Insert** / **Image**)
Inserting Gridlines (**Draw** / **Insert** / **Grid**)

RockPlot2D Measuring Tools

The RockPlot2D **Measure** menu contains four tools used to compute measurements. Computed measurements are displayed in the "RockPlot2D data window" that sits to the right of the graphic window. This information can be copied to the clipboard for pasting into other applications.

Examples: Measure hole to hole distances to determine good grid model node spacing. Measure fracture bearings off a map for display as a rose diagram.

See Help / Contents / RockPlot2D / Measuring Tools for step-by-step instructions about computing the following measurements within the RockPlot2D window:

Measuring the area within a polygon (**Measure** / **Area**)
Measuring the bearing of a line (**Measure** / **Bearing**)
Measuring the distance between two points (**Measure** / **Distance**)
Measuring the perimeter length of a polygon (**Measure** / **Perimeter**)

RockPlot2D Digitizing Tools

The RockPlot2D **Digitize** menu contains four tools used to capture map or diagram coordinates for points, lines, polylines, and polygons that are drawn by the user. Digitized coordinates are displayed in the "RockPlot2D data window" that sits to the right of the graphic window. This information can be copied to the clipboard for pasting into other applications. In addition, these digitized items can be can be appended to the underlying map or other graphic image.

Examples: Define a polygonal area on a map to be used to filter your grid or solid models. Digitize a fault trace polyline for use in gridding.

See Help / Contents / RockPlot2D / Digitizing Tools for step-by-step instructions about digitizing the following items within the RockPlot2D window:

Digitizing points (**Digitize** / **Points**).

Digitizing lines (**Digitize** / **Lines**).

Digitizing polylines (**Digitize** / **Polylines**).

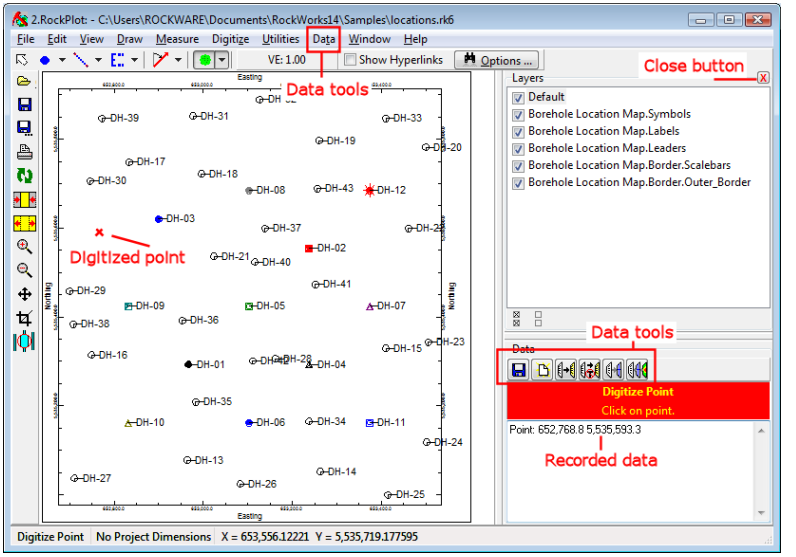
Digitizing polygons (**Digitize** / **Polygons**).

Measurement and Digitizing Options

Use the **Options** command in the RockPlot2D **Measure** and **Digitize** menus to establish settings for the measurement and digitizing tools.

The RockPlot2D Data Window

The RockPlot2D "Data Window" is displayed to the right of the RockPlot2D image window. It is used to display computed measurements and coordinates which result from the use of the **Measure** and **Digitize** menu tools. Each plot window that is open will have its own data window.



The RockPlot2D Data Window contains the following tools which can help you manage your measurements or digitized coordinates. These tools are available as buttons above the Data Window, or as commands in the **Data** menu.

Save: Saves the contents of the data window in a text file.

Clear: Clears all entries so that you can start a new data listing. You will NOT be warned that data will be lost.

Copy all Data: Copies all data, including numbers and text labels, to the Windows clipboard for pasting elsewhere. Below is an example of what's copied to the clipboard for three points digitized using the **Digitize** / **Points** command:

Point: 7,303.22 11,324.51
Point: 8,885.57 10,898.5
Point: 10,346.2 12,846

! Don't use Ctrl+C to copy the data displayed in the data window. That command is reserved for copying the current plot - the picture itself - to the clipboard.

Copy Numeric Data: Copies numeric data only (computations and/or digitized coordinates) to the Windows clipboard for pasting elsewhere.

Below is what's copied to the clipboard for the same three points as shown above:
7,303.22 11,324.51
8,885.57 10,898.5
10,346.2 12,846

! Don't use Ctrl+C to copy the data displayed in the data window. That command is reserved for copying the current plot - the picture itself - to the clipboard.

New Graphic: Creates a new plot window containing the graphic representation of the Digitized items (points, lines, polylines, and/or polygons) listed in the data window. The line style and color in which the lines are to be drawn should be established under **Digitize** / **Options** prior to creating the new graphic.

Append Current Graphic: Creates a new plot window containing the graphic representation of the digitized items (points, lines, polylines, and/or polygons) which are listed in the data window, overlaying the existing image in the current plot window. The line style and color in which the lines are to be drawn should be established under **Digitize** / **Options** prior to creating the new graphic.

! You need to use the data tools shown above to store the data in the clipboard or record the data as graphic entities before closing the plot window, or you'll lose all of the data items. The data items are not stored in the graphic RK6 file.

! The **Measure** and **Digitize** items are held in temporary memory only. If you redraw the image (using Zoom In, Zoom Out, Best Fit, Stretch, or Vertical Exaggeration) the drawn items will disappear from the graphic display. Since they are recorded, however, in the Data Window, the Copy all Data, Copy Numeric Data, New Graphic, and Append Current Graphic tools are still available.

! The Data Window is not designed for you to edit the coordinates or measurements there. Thus, there is no Paste command for the Data Window. You may utilize either of two copy-data buttons, described below, for copying the data to the Windows clipboard for pasting elsewhere.

See also the Drawing Tools (page 218) and ReportWorks (page 241) for an interactive page layout and drawing window.

Manipulating RockPlot2D Files

Locating the Closest Point

RockPlot2D has a nifty tool that allows you to search either the Borehole Manager or the RockWorks Utilities datasheet for the data that lies closest to a location you select on a map. With a map displayed in the RockPlot2D window, simply right-click on the locations for which you wish to retrieve data. As above, confirm the coordinates to be searched (they'll be populated automatically based on your right-click selection), specify the data window and columns if necessary:

The program will search for the requested information and display the data record closest to the selected point.

Help / RockPlot2D / Manipulating RockPlot2D Images / Locating the Closest Point.

Adding Border Annotations to RockPlot2D Images

The RockPlot2D **Utilities** / **Annotate** command is used to add axis tick marks and labels representing coordinate units to a two-dimensional map, such as a sample map or contour map. In order to preserve the existing plot file, the annotated map will be loaded into a new RockPlot2D window.

! RockWorks also permits you to include this annotation when the map or diagram is being created.
If you wish to combine maps (via the **Append** command), you should combine the maps first, then annotate them.

See Help / Contents / RockPlot2D / Manipulating RockPlot2D Files / Adding Border Annotations to RockPlot2D Images.

Adding Legends to RockPlot2D Images

The **Legend** tool in the RockPlot2D **Utilities** menu is used to add a legend to a map or diagram that is displayed on the screen, and to display the new map in a new RockPlot2D window. The legend can include any combination of the following items: Bitmaps (logos, etc.), titles, a north arrow, x-axis scale bar, y-axis scale bar, symbol index, pattern index, color index, line style index, and seven lines of notes. The legend can be appended to the right edge or the lower edge of the map or diagram.

! Note: With the new drawing tools (page 218) that have been added to RockPlot2D, much of the functionality of the Legend tool is replaced by these interactive, point and click tools. However, if you will be running RCL scripts, the Legend tool can be very useful since they are menu-based.

See also: ReportWorks (page 241) for an interactive page layout tool.

See Help / Contents / RockPlot2D / Manipulating RockPlot2D Files / Adding a Legend to a 2D Map or Diagram.

Rescaling 2D Plot files

The RockPlot2D **Utilities** / **Rescale** command is used to change map or diagram coordinates using one of two available schemes:

- Rescale by establishing a new X,Y origin coordinate and scaling the X and Y axes by a constant value.
- Rescale by establishing new boundary coordinates for one or more axes.

Note that these rescaling schemes change the actual coordinates that are stored for the lines, symbols, and such in a map or diagram. In order to preserve the existing plot file, both utilities create a new plot window for display of the rescaled map or diagram.

If you do not need to change the coordinates of the plot file but simply want to change the scale at which it is printed, this is done within RockPlot2D's Print utility itself. See Printing RockPlot2D Files (page 210) for more information. Or, if you want to change the scale at which it is viewed on the screen, there are zoom-in and zoom-out tools for this – see Viewing RockPlot2D Files (page 212).

Help / Contents / RockPlot2D / Manipulating RockPlot2D Files / Rescaling 2D Plot Files.

Clipping RockPlot2D Files

The RockPlot2D **Utilities** / **Clip** command is used to extract from an existing map or diagram all of the contents that lie within a user-declared rectangular area. The clipped image is displayed in a new RockPlot2D window.

This tool is also available using the Clip button in the left-hand toolbar.

Help / Contents / RockPlot2D / Manipulating RockPlot2D Files / Clipping Two-Dimensional Images.

Converting Plot File Coordinates

The **Degrees to UTM** and **UTM to Degrees** commands in the RockPlot2D **Utilities** menu are used to convert plot file coordinates from longitude / latitude decimal degrees to Universal Transverse Mercator (UTM) meters or feet, and vice versa. The converted map is displayed in a new RockPlot2D window.

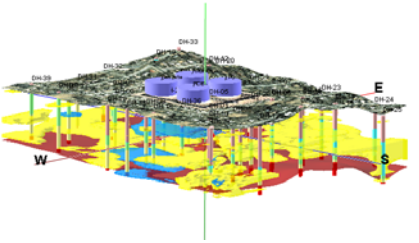
! These utilities convert graphic coordinates - the coordinates that are stored for each line, symbol, etc., in the plot file. If you wish instead to convert the original X,Y data coordinates that are listed in your datasheet, you can do so using the tools in the RockWorks RockWorks Utilities **Coords** menu or the Borehole Manager's **Map** menu.

Help / Contents / RockPlot2D / Manipulating RockPlot2D Files / Converting Diagram Coordinates.

Notes

Chapter 20 - RockPlot3D

RockPlot3D Overview



RockPlot3D is a true 3-dimensional display tool that is used by the RockWorks Borehole Manager and RockWorks Utilities for display of 3D objects, such as stratigraphic and water level surfaces, solid models, strip logs, and other items such as bitmaps and storage tanks. These items can be displayed individually, or in combination as shown above.

RockPlot3D permits interactive movement of the display (rotate, zoom, pan) and easy viewing and hiding of image objects.

Managing RockPlot3D Files

This section discusses the process of opening, appending, and saving "R3DXML" files that are displayed in the RockPlot3D window.

Creating a new RockPlot3D window

A new RockPlot3D window is created automatically any time that a 3-dimensional image is created within RockWorks. Multiple RockPlot3D windows may remain open at any time.

If you are working in RockWorks and wish to open an existing image that has already been saved as an R3DXML file, you can do so by opening a new RockPlot3D window first: Select the **File** / **RockPlot3D** menu option, or click on the **RockPlot3D** toolbar button (if displayed). Use **Tools** / **General Preferences** to turn on the toolbar buttons.

Help / Contents / RockPlot3D / Managing RockPlot3D Files / Creating a New RockPlot3D Window.

Opening a RockPlot3D XML File

RockPlot3D saves its views in files with a file name extension ".R3DXML".* If you have already saved a view in RockPlot3D, you can open it again into the program at any time

using the **File** / **Open** command. Browse for the name of the .R3DXML file you wish to open, and it will be displayed in the RockPlot3D window.

! You can also open a saved RockPlot3D XML view using the Project Manager: just double-click on one of the R3DXML or XML files in the project, and it will be opened into a new RockPlot3D window.

(* Earlier versions of RockPlot3D saved views with the extension "XML". You can still open these files using the Project Manager and the **File** / **Menu** option. Even older versions of RockPlot3D saved views in "R3D" files which have a different structure than R3DXML. This format is still available via **File** / **Open**, but R3DXML is default.)

Help / Contents / RockPlot3D / Managing RockPlot3D Files / Opening a RockPlot3D R3DXML File.

Appending Multiple RockPlot3D Views

RockPlot3D permits you to combine 3D views by appending the data objects in one R3DXML * file to the end of an existing view.

1. If necessary, open the R3DXML file to which another file is to be appended (above).
2. Choose the **File** / **Append** menu command and click **Select**.
3. In the displayed window, locate the existing R3DXML (or older XML) file to append to the current view, click on its name to highlight it, and click ***OK***.

The program will load the data items from the selected R3DXML file and display them in the current view. The program will automatically update the view's dimensions if necessary to accommodate the new data elements.

4. To save this new view, choose the **Save** command to save it under the *same* file name as the original scene, or the **Save As** command to assign the combined scene a *new name*. (See Saving RockPlot3D Views, below.)

! The view being appended should reside in the same folder as the original R3DXML file. If it does not, be warned that any files liked to the appended view (MOD files, images, etc.) will need to be located for the program the next time the saved, appended image is opened.

! If the scene being appended has radically different coordinate ranges, you may get a strange-looking display. Be sure the data elements being appended really overlay each other.

See also: Saving a RockPlot3D view as a Zip file (page 227).

(* Earlier versions of RockPlot3D saved views with the extension "XML". You can still open these files into RockPlot3D. Even older versions of RockPlot3D saved views in "R3D" files which have a different structure than R3DXML. This format is still available via **File** / **Open**, but R3DXML is default.)

Help / Contents / RockPlot3D / Managing RockPlot3D Files / Appending Multiple RockPlot3D Views.

Saving a RockPlot3D View

Follow these steps to save a RockPlot3D view or changes made to an existing view:

1. If the scene is untitled (has no name) or if it has a name and you wish to save under that name, click on the **Save** button, or choose **File** / **Save**.

   If the scene is currently untitled, you can type in a name for the scene and click ***OK***. The default file name extension is R3DXML.

2. If you wish to save the scene changes under a different name, choose the **File** / **Save As** command.

   Type in the new name to assign to the scene, and click ***OK***. The default file name extension is R3DXML.

! RockPlot3D stores in the R3DXML file a list of the data items, as well as the status of the reference and data items: whether the item is "on" or "off", its transparency or color, and other characteristics. It also now embeds grid model data for surfaces and fence panels.

! RockPlot3D does ***not*** store in the R3DXML file the actual data contained in solid models, bitmap images, or other file-based items displayed in the current view whose names are shown in the Linked File List pane. Instead, it stores their ***file names***. You need to be sure to keep all of these files together in the same folder.

See also: Save a RockPlot3D view as a zip file (below) for information about zipping the R3DXML file and all linked files.

! RockPlot3D does not store any display information in the R3DXML file, such as last viewpoint, lighting, or vertical exaggeration.

Help / Contents / RockPlot3D / Managing RockPlot3D Files / Saving a RockPlot3D View.

Zipping a RockPlot3D View and its Linked Files

Because RockPlot3D's "R3DXML" files can contain links to bitmap images, solid models, and other external files, it can be confusing to keep track of what files to send to co-workers for viewing, or what files you need to keep when you are house-cleaning. RockPlot3D offers a save option that stores the R3DXML and all linked files as a ZIP file. Follow these steps:

1. Click on the **File** / **Zip All Linked Files** menu command.
2. In the ***File Name*** prompt, type in the name for the ZIP file, and then click ***Save*** button.

RockPlot3D will create a ZIP-format file containing the R3DXML file and all linked solid models, bitmaps, color tables, and other linked files. (All linked file names are displayed in the "Linked File List" pane of the RockPlot3D window.) The default file name extension is ".ZIP".

! RockPlot3D cannot open a ZIP-format file. To later access the contents of the ZIP file, you will need to have a software program capable of extracting files from the ZIP archive.

Help / Contents / RockPlot3D / Managing RockPlot3D Files / Zipping a RockPlot3D View and its Linked Files.

Printing a RockPlot3D View

Follow these steps to print a 3D image:

1. If necessary, open the R3DXML or XML file you wish to print.
2. Adjust the image view to your satisfaction. This includes, but is not limited to, the rotation angle, zoomed-in state, vertical exaggeration, etc. This is important because the printing tool captures a bitmap image that's based on what's displayed in the 3D View.
3. Select the **File** / **Print** menu command.
4. Be sure the printer information displayed along the right side of the screen is correct. (This information is taken directly from the Window-installed printer driver.) Double-check that the displayed printer name is the one to which the output should be sent. Use the printer's ***Properties*** or ***Setup*** button to access printer-specific settings.
5. Along the left side of the print window, you can choose from ***Draft*** quality (150 dots per inch or dpi), ***Good*** quality (300 dpi), or ***Best*** quality (600 dpi) output.
6. Click ***OK*** to send the print job to the printer.

TIPS:

If you need printouts larger than a single page, we recommend that you export the image to a high resolution JPG or BMP image, and then print from a graphic application. (See Exporting RockPlot3D Images, page 237.)

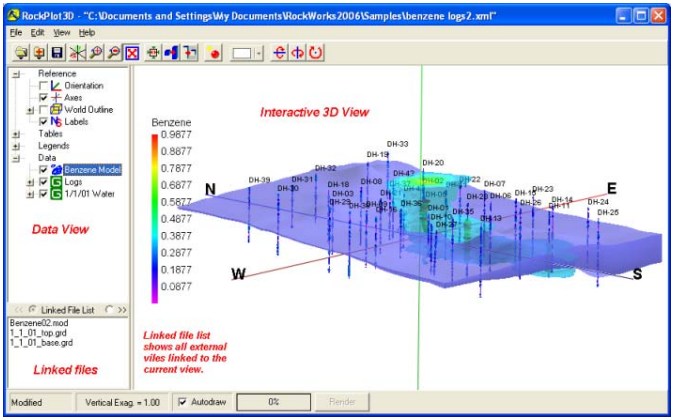
The general shape of the image must be adjusted before selecting the **File** / **Print** command (see step #2). Unlike 2-dimensional (flat) images like contour maps, 3D images cannot be printed at a specific horizontal and vertical units-per-inch scale.

Help / Contents / RockPlot3D / Managing RockPlot3D Files / Printing RockPlot3D Images.

Viewing RockPlot3D Files

RockPlot3D is the plotting engine for all surfaces, fence diagrams, solid models and other 3-dimensional objects within RockWorks, and these images are plotted automatically into a RockPlot3D window on the screen as they are generated.

What you'll see when RockPlot3D first opens is a window with three panes: Your image will be displayed in the larger pane, a listing of the standard reference items and the current data items are shown in another, and a list of any linked files are in the third. The program is originally set up with the image pane on the right, but you can swap them



Once the image is plotted on the screen, you may do any of the following operations which are discussed in the Help topics below.

Help / Contents / RockPlot3D / Viewing RockPlot3D Files / …

Swapping the position of the image and data panes.

Changing the size of the 3D View pane.

Rotating the 3D view.

Zooming into/out of the view.

Moving the image in the 3D display (Pan).

Spinning the 3D image.

Selecting a pre-set view. (View / Above, Below, Plan View, Compass Points)

Selecting a custom view.

Changing the 3D view dimensions and vertical exaggeration.

Changing the lighting of the 3D view.

Changing the 3D view background color.

Turning off screen redraw. Draw

Manipulating RockPlot3D Images

The RockPlot3D screen contains an image pane (by default along the right), and a listing of the data items (by default in the pane to the left). Note that you can swap the placement of the image and data panes using the << and >> button above the linked file list.

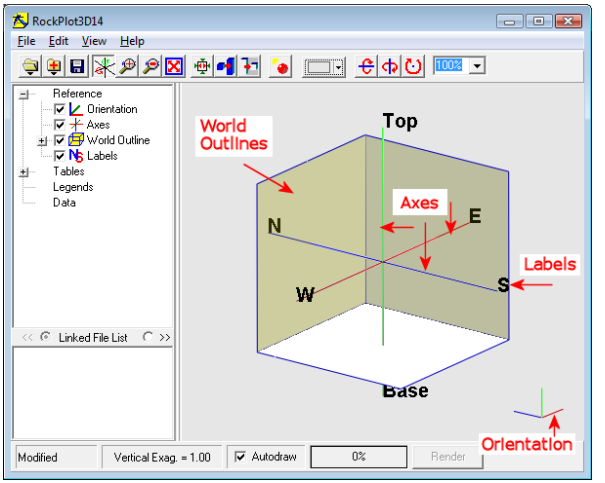
You can adjust interactively the view of the image in the 3D Image pane by following the instructions in Viewing RockPlot3D Files.

If you want to change the look of individual items in the Image view, that's possible, too. This section discusses these tools. This discussion is split up into the Reference Items, which are available for all RockPlot3D images, and the Data Items which are specific to each image created by RockWorks.

Help / Contents / RockPlot3D / Manipulating RockPlot3D Images.

Reference Items

RockPlot3D offers the following reference items used to orient yourself in the scene:



Orientation marker: Displayed in the lower-right corner of the 3D View, it shows the current orientation of the X-axis (red), the Y-axis (blue), and Z-axis or elevation (green). If you rotate the display, the orientation marker will be updated.

Axes: The X, Y, and Z (elevation) axes are plotted in the middle of the currently-defined scene dimensions.

World Outlines: Expand this item to access individual reference grids for the ***Top***, ***Base***, ***West***, ***North***, ***East***, and ***South*** boundaries of the scene. Right-click on any item to adjust the color, fill, and opacity of the reference grids. Choose **View** / **Dimensions** to adjust the scene dimensions.

Axis labels, which note the Top, Base, West, North, East, and South directions.

These reference items are listed at the top of the Data List in the right pane of the RockPlot3D screen.

Help / Contents / RockPlot3D / Manipulating RockPlot3D Images / Reference Items…

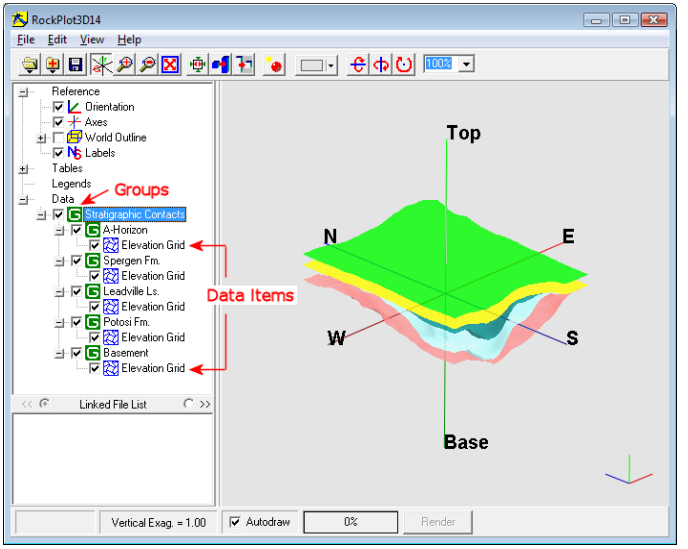
Turning on/off the reference items.

Changing the axis label text.

Changing the appearance of the RockPlot3D reference grids.

Data Items

The "Data Items" are the logs, surfaces, solids, or other entities that were created by RockWorks. They can be displayed individually or they can be displayed in groups.



Groups of items are shown with the Group symbol. Simply click on the Group's "+" button to view the data items within. Expand any data item's "+" button to view its components.

Each of the data types has characteristics you can modify right within RockPlot3D. Just double-click on the item in the Data pane to access the settings.

Help / Contents / RockPlot3D / Manipulating RockPlot3D Images / Data Items / …

Turning on/off the RockPlot3D Data Items.

Adding New Data Groups in RockPlot3D.

Dragging and Dropping RockPlot3D Data Items.

Changing the RockPlot3D Surface Settings.

Changing the RockPlot3D Isosurface settings.

Changing the RockPlot3D Morph Settings.

Change the RockPlot3D Solid Model Settings (for solid models displayed with all voxels).

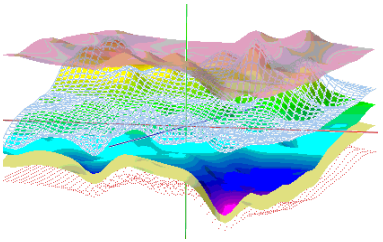
Changing the RockPlot3D slice settings (for slices inserted into solid models).

Changing the RockPlot3D Fence Panel Settings.

General RockPlot Data Items – Adjusting Transparency.

RockPlot3D Surface Settings

RockPlot3D can display 3-dimensional surfaces that are based on grid models. These might result from gridding X/Y/Elevation data in the RockWorks Utilities datasheet (**Map** / **Grid-Based Map**), from modeling a drawdown surface (**Hydrology** / **Drawdown Surface**), or from modeling stratigraphic surfaces in the Borehole Manager (**Stratigraphy** / **Structural Elevations**). Surfaces can be displayed individually or in groups.



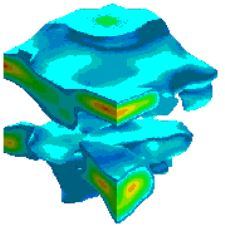
1. To access the surface settings, right-click on the surface item's name or icon in the right pane, and choose **Options**. You can also double-click on the surface item to access the grid options.

The program will display a Grid Options window in which you can adjust the color scheme, surface style, opacity, smoothing, and data filter.

Help / Contents / RockPlot3D / Manipulating RockPlot3D Images / RockPlot3D Data Items / Surface Settings / …

Adjusting the surface color scheme.
Adjusting the surface style.
Adjusting the surface transparency.
Adjusting the surface smoothing.
Applying a Z-value filter.

RockPlot3D Isosurface Settings



RockPlot3D can display 3-dimensional isosurfaces that are based on solid models. These might result from modeling X,Y,Z,G data in the RockWorks Utilities datasheet (**Solid** / **Model**), or from modeling quantitative downhole data in the Borehole Manager (**I-Data** / **Model**, **P-Data** / **Model**, **Fractures** / **Model**).

1. To access the isosurface settings, right-click on the item's name or icon in the right pane, and choose **Options**. You can also double-click on the isosurface item to access the options.

The program will display the Isosurface Options window in which you can adjust the color scheme, surface style, opacity, and smoothing. You can change the minimum G level enclosed in the isosurface "skin", and adjust the appearance of the model at the boundary edges. You can also insert horizontal and vertical slices.

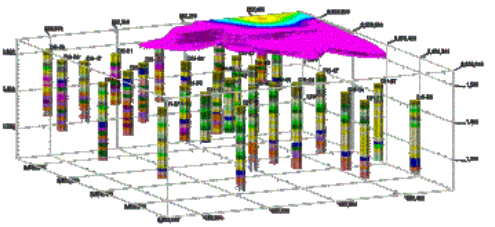
Help / Contents / RockPlot3D / Manipulating RockPlot3D Images / RockPlot3D Data Items / Isosurface Settings / …

Adjusting the isosurface color scheme.
Adjusting the isosurface style.
Adjusting the isosurface transparency.
Establishing the minimum iso-level.
Adjusting the isosurface smoothing.
Displaying the isosurface volume.
Adjusting the isosurface "cap" appearance.
Inserting solid model slices.

See also: RockPlot3D Solid Model Settings (page 234).

RockPlot3D Morph Settings

The RockWorks Utilities **Solid** / **Morph** tool is used to read a list of existing solid model files (*.MOD) and create a dynamic "movie" within RockPlot3D that shows time-based changes within these models. You can specify any number of intermediate, transitional models be generated between the existing models.



1. To access the morph settings, right-click on the item's name or icon in the right

pane, and choose **Options**. You can also double-click on the morph item to access the options.

The program will display the Morph Options window in which you can run the morphed sequence, export to an AVI file, and adjust isosurfaces' color scheme, surface style, and opacity. You can change the minimum G level enclosed in the isosurface "skin", and adjust the appearance of the model at the boundary edges.

Help / Contents / RockPlot3D / Manipulating RockPlot3D Images / RockPlot3D Data Items / Morphed Model Settings / …

Running the Morhed Solid Model Sequence.
Saving the Morhed Sequence as an AVI File.
Adjusting the isosurface color scheme.
Adjusting the isosurface style.
Adjusting the isosurface transparency.
Establishing the minimum iso-level.
Displaying the isosurface volume.
Adjusting the isosurface "cap" appearance.

RockPlot3D Voxel Model Settings

RockPlot3D can display solid models as isosurfaces or as "all voxels". The All Voxel display is typically used for display of lithology solid models or Boolean models that result from the RockWorks Utilities **Solid** menu filtering tools, but can also be used for I-Data (geochemistry) or P-Data (geophysical) models.

1. To access the solid model settings, right-click on the item's name or icon in the right pane, and choose **Options**. You can also double-click on the solid model item to access the options.

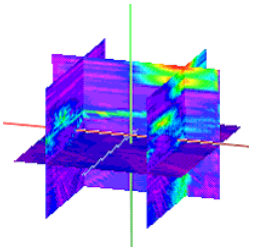
The program will display the Solid Model Options window in which you can adjust the color scheme, surface style, opacity, and smoothing. You can adjust the minimum and maximum G values displayed, and you can insert horizontal and vertical slices.

Help / Contents / RockPlot3D / Manipulating RockPlot3D Images / RockPlot3D Data Items / Solid Model Settings / …

Adjusting the solid model color scheme.
Adjusting the solid model style.
Adjusting the solid model transparency.
Adjusting the solid model smoothing.
Filtering G values from the display.
Displaying the RockPlot3D solid model volume.
Inserting solid model slices.

See also: RockPlot3D Isosurface Settings (page 233).

RockPlot3D Slice Settings



RockPlot3D can display 3-dimensional solid models as isosurfaces or using all voxels. In addition, you can display horizontal and vertical slices within the solid model (see Isosurfaces / Inserting Slices or Solid Models / Inserting Slices in the Help messages).

Once created, these solid model slices then become data items of their own with their own. You can adjust the surface appearance, transparency, smoothing, and position.

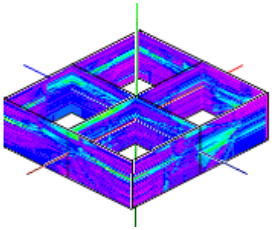
1. To access the slice settings, right-click on the slice's name or icon in the right pane, and choose **Options**. You can also double-click on the slice item to access the options.

The program will display the Slice Options window.

Help / Contents / RockPlot3D / Manipulating RockPlot3D Images / RockPlot3D Data Items / Slice Settings / …

Adjusting the slice's surface style.
Adjusting the slice's color scheme.
Adjusting the slice's transparency.
Adjusting the slice's smoothing.
Adjusting the slice's position.

RockPlot3D Fence Panel Settings



RockPlot3D displays fence diagrams as vertical panels which are extracted from solid models. These might result from modeling I-data, P-data, fracture, or lithology data in the Borehole Manager (**I-Data** / **Fence**, **P-Data** / **Fence**, **Fractures** / **Fence**, **Lithology** / **Fence**). Fence diagrams can also be generated using the RockWorks Utilities **Solid** / **Fence** tool.

Each fence panel is stored as a "vertical grid" file (fence*.grd) which will be shown as linked to the diagram. You can modify a number of the fence panel characteristics.

! Stratigraphy and water level fence panels are drawn a little differently (not from solid models) and do not offer the same options as solid-model-based fences.

1. To access the vertical grid settings, expand the fence diagram group and expand the fence panel's group (if necessary). Then, right-click on the vertical grid item's name or icon in the right pane, and choose **Options**. You can also double-click on the vertical grid to access the options.

The program will display a Grid Options window in which you can adjust the color scheme, surface style, opacity, smoothing, and data filter.

Help / Contents / RockPlot3D / Manipulating RockPlot3D Images / RockPlot3D Data Items / Fence Panel Settings / …

Adjust the fence panel's color scheme.
Adjust the fence panel's surface appearance.
Adjust the fence panel's transparency.
Adjust the fence panel's smoothing.
Apply a fence panel G-value filter.

General RockPlot3D Data Items - Adjusting Transparency

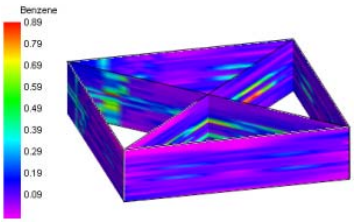
Some of the more complicated components of RockPlot3D displays (isosurfaces, grid surfaces, etc.) have lots of options for adjusting colors, filtering data, and more. These are discussed earlier in this section.

Some components of the displays are quite simple – they contain only a general transparency setting.

See Help / Contents / RockPlot3D / Manipulating RockPlot3D Images / Data Items / General RockPlot3D Data Items / How to…

Adjust the transparency of a group of items.
Adjust the transparency of individual items.

RockPlot3D Legends



A "legend" is a key to colors and data values or data items that can be generated automatically by RockWorks or can be added interactively in RockPlot3D. The picture below shows a legend correlating colors with geochemical values in a fence diagram.

See Help / Contents / RockPlot3D / Manipulating RockPlot3D Images / RockPlot3D Legends / …

Adding a legend to an existing image.
Adjusting the legend settings.

RockPlot3D Type Tables

RockWorks project databases store definitions of lithology materials, stratigraphic formations, and well construction materials in "Type Tables". Each time RockWorks creates any kind of 3D image, it reads these data Types and stores the material/formation names and other settings in the RockPlot3D view. This enables easy configuration of legend colors and names.

The Type Table information is stored under the Tables heading in the RockPlot3D data pane. You can edit the contents of these tables to change the appearance of the legends.

! The changes you make to the tables in RockPlot3D will not affect any models, surfaces, fence panels, or logs in the 3D display. Their colors were established upon diagram creation. You can adjust them manually using the settings described under RockPlot3D Data Items.

See Help / Contents / RockPlot3D / Manipulating RockPlot3D Images / RockPlot3D Tables / …

Editing the RockPlot3D Lithology Table.
Editing the RockPlot3D Stratigraphy Table.
Editing the RockPlot3D Well Construction Table.

Importing Images into RockPlot3D

While the RockPlot3D **File** / **Open** command is used to open existing RockPlot3D (.R3DXML) files, the **File** / **Import** command can be used to display other file types:

DXF: Use this **File** / **Import** tool to display 2D or 3D DXF files in an existing RockPlot3D window. The DXF file will be appended to any items already displayed. This tool imports DXF LINE, POLYLINE, LWPOLYLINE, 3DFACE, SOLID, and CIRCLE (filled) commands.

See Help / Contents / RockPlot3D / Importing Images into RockPlot3D

Exporting RockPlot3D Images

The RockPlot3D program saves image information in an "R3DXML" file, with links to external bitmaps, solid models, grid models, etc. that are displayed in the image. (See Saving Files, page 227.)

RockPlot3D also offers export of the screen display as other image types: BMP (Windows Bitmap), JPG (JPEG), PNG (Portable Network Graphics), TIFF (Tagged Image File Format), AVI (animation), and ESRI 3D Shapefile formats. These tools are in the **File** / **Export** menu command.

See Help / Contents / RockPlot3D / Exporting Images from RockPlot3D / ...

Exporting RockPlot3D images to a Bitmap format.

Exporting RockPlot3D images to a JPEG format.
Exporting RockPlot3D images to a PNG format.
Exporting RockPlot3D images to a TIFF format.
Exporting a RockPlot3D animation to an AVI (animation) format.
Exporting RockPlot3D images fo ESRI 3D Shapefiles.

RockPlot3D Reference

Troubleshooting File / Open

RockPlot3D stores the current 3D view in an "R3DXML" file*. Some of the information in the view is recorded in the XML file itself; this includes all of the reference and data item names, whether the items are set to "on" or "off", their current attributes, surface and fence grid model data, and much more.

What is not stored in the R3DXML file, however, is the contents of any RockWorks-created solid models or bitmap images that may be displayed in the 3D view. In other words, a large solid model file (MOD) containing contaminant data is not stored in the R3DXML file. Instead, its file *name* is stored in the R3DXML file, and then RockPlot3D loads the data itself from the linked file.

The names of files linked to the current view are displayed in the “linked file list” pane below the data pane of the RockPlot3D window. RockPlot3D assumes that all files referenced in the R3DXML are stored in the same folder as the XML file.

So, what this means is that if the R3DXML file and any linked solid model, bitmap, or other files get separated, you may see the following message when RockPlot3D tries to open that R3DXML file, or append that R3DXML file to another file:

```
Filename has been moved.  Do you want to browse for this file?
```

1. Click the ***Yes*** option if you want to locate the missing file(s), and use the standard Windows to change folders and/or drives as necessary.

   Click ***No*** if you prefer not to locate the missing file(s), and the scene will be loaded without those data elements.

(* Earlier versions of RockPlot3D saved views with the extension “XML”. You can still open these files using the Project Manager and the **File** / **Menu** option. Even older versions of RockPlot3D saved views in "R3D" files which have a different structure than R3DXML. This format is still available via **File** / **Open**, but R3DXML is default.)

Troubleshooting OpenGL

RockPlot3D uses OpenGL to deliver the responsive, interactive scenes you see on the screen. You'll get the best performance from RockPlot3D on a computer that contains a video card with OpenGL support.

How do you know if you have a video card that supports OpenGL? The easiest way is to access the RockPlot3D **Help** menu, click on the **About** item, and then click on the **OpenGL Troubleshooting** tab that's displayed there. The window will display the driver that's installed on your system.

If there is a driver installed, its manufacturer and renderer and version will be listed. You should opt for the ***Use Hardware Acceleration*** setting if your computer contains a good card with a driver. You will be able to display and manipulate bigger images better.

If no driver is installed (typical of many laptops) you may see something like ***Driver Vendor: Microsoft Corporation, Driver Renderer: GDI Generic***. In this situation, RockPlot3D will make use of RAM memory to provide the umph to drive the graphics. You should choose the ***Use Software Acceleration*** setting. For this to work effectively, we recommend that you have lots of RAM (more than 256 MB) and a faster processor (400 mHz or faster Pentium III CPU).

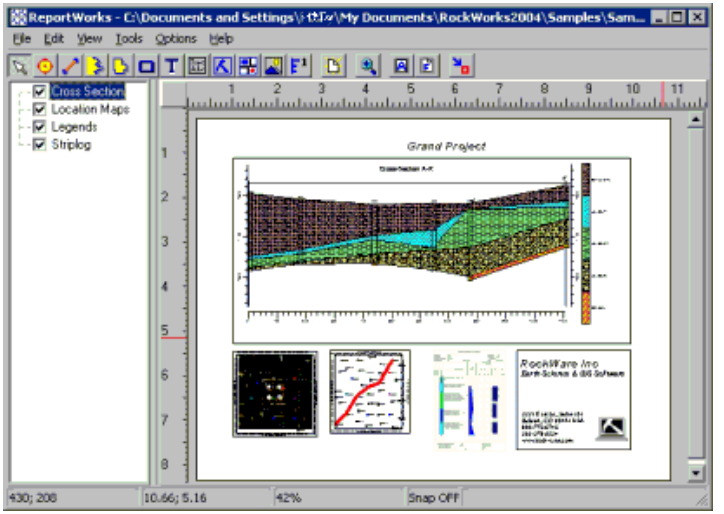
If the 3D images are slow to redraw on your computer, you can remove the checkmark from the Autodraw option along the bottom of the RockPlot3D window. The image will only be updated after rotation, stretch, view change, etc. when the ***Render*** button is clicked.

Notes

Chapter 21 – ReportWorks

ReportWorks Overview

The ReportWorks program is a new page layout tool that's shipped with RockWorks. It offers tools for laying out pages with RockWorks-generated graphics, imported graphics, text, shapes, and more. It's a really nice complement to all of the graphic options in the RockWorks program, allowing you to combine them for presentation and printing on a single page.



There are several ways you can access the ReportWorks program:

- If you are at the main RockWorks program window, select the File / Reportworks menu option.
- Click on the ReportWorks toolbar button . See Tools / General Preferences to turn on the bank of toolbar buttons.
- If you are in RockPlot2D, choose the **File** / **ReportWorks** command to open a new, blank ReportWorks window.
- Outside the RockWorks program, you can use the Windows Start menu to locate the shortcut to the ReportWorks program in the RockWorks shortcut folder.
- Outside the RockWorks program, you can use Windows Explorer to locate the program file "ReportWorks.exe" in the RockWare\ReportWorks2006 program folder, and double-click on it to launch the application.

Once you have a ReportWorks window displayed, you can use the **File** / **Page Setup** menu command to set up your new page (size and orientation) and the **Tools** menu options to insert shapes, text, images, and more to the current page. Or, use the **File** / **Open** menu command to open an existing RW6 file.

Managing ReportWorks Files

Creating a New ReportWorks Document

Use the ReportWorks **File** / **New** menu option to create a new page layout document.

1. With the ReportWorks program displayed on the screen, select the **File** / **New** option.
2. If there is an existing document already displayed and it has not been saved, the program will display a warning. Click ***Yes*** to save the existing document, or ***No*** to close the existing document without saving.

A new, blank page will be displayed on the screen.

3. Use the **File** / **Page Setup** option to define the page size and layout.
4. Use the **Tools** menu options to insert graphics and shapes.

Help / Contents / ReportWorks / Managing Files / Creating a New ReportWorks Document.

Opening Existing ReportWorks Images

If there is no ReportWorks window yet displayed on the screen, you can create a new ReportWorks window first. (See the previous topic.)

1. To open an existing RockWorks Report “RW6” graphic file, select the **Open** command from the **File** menu and browse for the file to open. ReportWorks opens files that were stored in a “RW6" file format, or a "RWR" format from older versions of ReportWorks. (See the **Tools** menu for options that insert other graphic file types into the current page layout.)

! Note that if you are opening an older ReportWorks RWR file and it contains older RockPlot2D images (RKW rather than RK6), those images will be omitted. You will need to open the RKW files into the current version of RockPlot2D, update them to the new RK6 format, and re-insert them into the ReportWorks document.

! If the existing RW6 document contains linked images and those images are moved, you’ll see a warning that they cannot be located. You can browse for these images to update their paths.

Help / Contents / ReportWorks / Managing Files / Opening Existing ReportWorks Images (RWR files).

Combining ReportWorks Documents

ReportWorks permits you to combine multiple RW6 files using the File / Append option. This can be a handy way to append a standard company legend to your layouts.

1. Select the **File** / **Append** command.
2. Browse for the name of the RW6 file to be appended to the current view and click the Open button. The program will add the contents of that file to the current document.

! Be warned that if you have images in your ReportWorks documents, and if you share the documents across different projects, you might consider embedding the images so that file paths don't get messed up. See the discussion of embedding versus linking in the drawing tools topics.

Help / Contents / ReportWorks / Managing Files / Saving ReportWorks Documents.

Saving ReportWorks Documents

1. Select the **File** / **Save As** command.
2. Type in the name under which to store the ReportWorks layout on disk, and click on the Save button.

ReportWorks always stores plot files in its own “RW6" format. If you need to export the image to a BMP, JPG, or PNG format, you can use the Export command.

Help / Contents / ReportWorks / Managing Files / Saving ReportWorks Documents.

Printing ReportWorks Diagrams

You can output the image contained in a ReportWorks document to your printer using the **File** / **Print** command.

! It is assumed that you've already established the page layout prior to designing and printing, since the page will be printed as it's displayed in the ReportWorks screen.

1. Open an existing ReportWorks document or create a new document as necessary.
2. Double-check the page's layout using the **File** / **Page Setup** option.
3. To print the document, choose **File** / **Print**.

Your current printer's dialog box will be displayed. The options that are available will vary from depending on printer type. Typically, you would click the Properties or Options button to access your printer's settings, such as page size and orientation.

4. To send the document to the printer, click the ***OK*** button in the Print window.

Help / Contents / ReportWorks / Managing Files / Printing ReportWorks Documents.

Exporting ReportWorks Documents

The ReportWorks program saves plot files on disk in its own "RW6" format. If you want to save the plot in a BMP (Windows Bitmap), JPG (JPEG), or PNG (Portable Network Graphics) format you can do so with the **Export** command (**File** menu).

1. If necessary, open the RW6 file you wish to export.
2. Select the **Export** command from the **File** menu and select the desired export option.
3. Enter the requested information in the displayed program window.

   File Name: Click on the small open-file button to type in the name to assign the exported file.

   Color Depth: Choose from the drop-down list box the color resolution you wish to use for the output raster image. As you increase the color resolution, the output file will increase in size. For good color depth, you should probably choose 24 bits/pixel.

   ! Changing the pixels per inch and/or colors per pixel does not change the printable size of the graphic but instead the resolution of the image and the size on disk of the output file.

   Resolution (DPI): This setting defaults to 96 and will determine the resolution of the output graphic in dots or pixels per inch. As you increase the number of dots per inch, the disk size of the output file will increase. If you want to display the image on screen only, a resolution of 96 will probably be adequate. If you want to print the image at high resolution, you should increase the resolution to at least 150 pixels per inch. (We use 200 - 300 for publication quality graphics.)

   Compression: (JPG and PNG only) These files can be created with varied compression; use the sliding bar to select the compression you wish to use (JPG) or choose Low/Medium/High for PNG. The greater the compression, the lower the quality of the output image and the smaller the disk size of the output file. The lower the compression, the higher the quality of the output image, and the larger the disk size of the output file.
5. Click OK when you are ready to continue.

The program will store on disk the current ReportWorks document in a Windows BMP, JPG, or PNG format at the resolution and color depth you specified.

Help / Contents / ReportWorks / Managing Files / Exporting ReportWorks Documents.

View and Layout Options

Establishing the ReportWorks Page Layout

Use the **File** / **Print Setup** tool to establish the size and orientation of your ReportWorks page. This is an important first step in designing a report so that you know the page's dimensions.

1. Create a new document in ReportWorks, or open an existing RW6 file into the program window.
2. Select **File** / **Print** Setup.
3. You will see the Print Setup window for your default printer, as installed in Windows. Here you can select a different printer if necessary, and you can click the printer's Properties button to select the paper size, and portrait (vertical) or landscape (horizontal) orientation.
4. Click OK when the settings are established to your liking.

The ReportWorks page view will be updated based on the page dimensions and orientation.

If you view your page in Full Screen mode, the printable area of your paper will be shown in white, against a gray background. The printable dimensions of the sheet are determined by your printer's software, not by ReportWorks.

See the **Tools** menu options for inserting graphic images and drawing shapes. See the **Options** menu for establishing the page units.

Help / Contents / ReportWorks / View and Layout Options / Establishing the ReportWorks Page Layout.

Establishing your ReportWorks Page Units

Use the **Options** / **Units** menu item to set your ReportWorks page units. This will determine the units displayed in the reference rulers, as well as the default units shown in scaling options.

1. Click on the **Options** menu and then on the **Units** item.
2. From the pop-up menu, select either **Inches** or **Centimeters**. This is a "toggle" item; selecting either from the menu will establish it as default.

The program will update the reference rulers with these units. These will also become the default scaling units for subsequent RockPlot images and geo-referenced raster images that you insert.

Help / Contents / ReportWorks / View and Layout Options / Establishing the ReportWorks Page Units.

Defining the ReportWorks Program Libraries

Use the **Options** / **Program Files** tool to establish the names of the pattern and symbol libraries to be used to draw patterns and symbols inserted into the page or those that are included in inserted RockPlot graphics. Neither RockWorks nor ReportWorks stores the actual pattern and symbol designs in the drawings, but instead links pattern and symbol numbers to a reference library; use this option to define which library to use.

Help / Contents / ReportWorks / Other Options / Defining the ReportWorks Program Libraries.

Drawing Tools

Working with Layers

ReportWorks allows you to organize the different items on a page into different "layers". These are groups of items that can be displayed or hidden with the click of a button. For example, you might keep your static legend items (company logos, maybe a pattern index) in one layer, while document-specific RockPlot or bitmap images might be kept in a separate layer.

Opening the program or creating a new ReportWorks document generates a single layer, named "Layer 1." Subsequent items that are drawn or inserted into the page are done so in that layer, until a new layer is created.

To ***add a layer*** to the current document, choose the **Tools** / **New Layer** menu item or click on the New Layer button. The program will add a new layer entry into the data pane along the left side of the window. Be sure to highlight a particular layer prior to adding items to your document; items are always added to the currently-highlighted layer. (See also "Moving Items," below.)

To ***select a layer*** to be active, simply click on its name in the data pane. Subsequent items that you add to your document will be added to that layer.

To ***rename a layer***, simply click on the layer in the data pane along the left side of the window, to highlight it. Then click on the layer's name so that you see the blinking cursor in the name's text. Edit/type in a new name. This can help you to be more specific with layer items, such as "company legend items" rather than "Layer2".

To ***move items between layers***, you need to use a cut-and-paste procedure. First, click on the layer name to which the item to be moved is currently associated. Left-click on the item to be moved to a different layer, and choose **Edit** / **Cut** (or type in Ctrl + X). Then, click on the name of the layer to which it is to be associated and select **Edit** / **Paste** (or type Ctrl + V). The item will be re-inserted into the document and associated with the specified layer.

To ***copy items between layers***, use a copy-and-paste procedure similar to that described above for moving items, but using the **Edit** / **Copy** command rather than the **Edit** / **Cut** command.

To ***display a layer's items***, insert a check-mark in the layer's check-box. To hide a layer's items from the display, remove the check-mark from the layer's name.

Help / Contents / ReportWorks / Drawing Tools / Working with Layers.

Inserting a Symbol into a ReportWorks Page

Use the **Tools** / **Symbol** menu command or toolbar button to insert a graphic symbol into an existing ReportWorks page. You can insert a symbol from the RockWare symbol library, or you can choose from some generic symbol shapes. Once the symbol is placed you can double-click on it (or right-click and choose Properties) to establish the symbol style, fill, outline, etc. The symbol can be resized by clicking on one of the corner handles and dragging larger or smaller. The symbol can be repositioned by clicking and holding anywhere on the symbol and dragging it to the new location.

Help / Contents / ReportWorks / Drawing Tools / Inserting a Symbol into a ReportWorks Page.

Drawing Lines, Polylines, Polygons, and Rectangles on a ReportWorks Page

Use the Reportworks **Tools** menu commands or toolbar buttons to draw straight lines, multi-segmented lines, closed polygons, and rectangles in an existing ReportWorks page. You can adjust the line style, thickess, and color, and the fill for polygons and rectangles.

Straight lines: or choose the Tools / Line menu command.

Polylines: or choose the Tools / Polyline menu command.

Polygons: or choose the Tools / Polygon menu command.

Rectangles: or choose the Tools / Rectangle menu command.

Double-click on the drawn item to view/adjust its settings, or right-click on it and choose Properties. Resize the item as you wish by clicking on one of the endpoint or vertex handles and dragging. Reposition the item as you wish by clicking and holding anywhere on the item and dragging it to the new location.

Help / Contents / ReportWorks / Drawing Tools / Inserting a Line / Polyline / Rectangle / Polygon into a ReportWorks Page.

Inserting Text into a ReportWorks Page

Use the **Text** or **Text Block** menu commands or toolbar buttons to insert either a single line of text or a text paragraph on an existing ReportWorks page. You can adjust the font type and size, color, and fill pattern/color.

Click on the Text toolbar button or choose the **Tools** / **Text** menu command to insert a single line of text, such as a title or label.

Click on the button or choose **Tools** / **Text Block** to insert text that can wrap into multiple lines or paragraph.

You can access the text options at any time by double-clicking on the text or by right-clicking and choosing Properties. Reposition the text label as you wish by clicking and holding anywhere on the text and dragging it to the new location.

Help / Contents / ReportWorks / Drawing Tools / Inserting Text / Multi-Line Text into a ReportWorks Page.

Inserting a RockPlot Map or Diagram (RK6 File) into a ReportWorks Page

Use the RockPlot (RK6) menu command or toolbar button to insert into a ReportWorks page a map, cross-section, or other 2D diagram generated by RockPlot2D and saved as a RK6 file. To insert the image, position the cursor in the page where the one corner of the image is to be placed, and click and hold the left mouse button to insert it. With the button still pressed in, drag to the location of the diagonal corner point, and release the mouse button. As you drag, you'll see a "rubber band" image of the shape's outline

You can adjust the diagram's scaling, clipping, outline, and fill pattern/color. See the Bitmap tool for inserting more generic graphic images. The Bitmap tool can be a good option if the RK6 image is slow to redraw in the ReportWorks page, or if there are offset or scaling problems.

You can access the image's options at any time by double-clicking on the image or by right-clicking and choosing Properties.

You can resize the image block by first single-clicking on the image to see the boundary "handles." Then, click and hold on any of the handles on the corners or edges and drag to the new position. Release the mouse button when the boundary's edges are in the correct position.

Reposition the image as you wish by clicking and holding anywhere on the text and dragging it to the new location.

Help / Contents / ReportWorks / Drawing Tools / Inserting a RockPlot Map or Diagram into a ReportWorks Page.

Inserting a Raster Image into a ReportWorks Page

Use the **Raster** menu command or toolbar button to insert into a ReportWorks page a BMP, JPG, PNG, TGA, TIFF, EMF, or WMF image. You can adjust the image's scaling and outline. See the RockPlot (RK6) tool for inserting RockPlot-generated graphic images, and the Georaster tool for raster images with world coordinates.

To insert the image, use your mouse to position the cursor in the page where the one corner of the image is to be placed, and click and hold the left mouse button to insert it. With the button still pressed in, drag to the location of the diagonal corner point, and release the mouse button. As you drag, you'll see a "rubber band" image of the shape's outline.

You can access the image's options at any time by double-clicking on the image or by right-clicking and choosing Properties.

You can resize the image block by first single-clicking on the image to see the boundary "handles." Then, click and hold on any of the handles on the corners or edges and drag to the new position. Release the mouse button when the boundary's edges are in the correct position. The raster image will be redrawn within the new boundary using the selected stretch or best-fit scaling you've selected.

Reposition the image as you wish by clicking and holding anywhere on the text and dragging it to the new location.

Help / Contents / ReportWorks / Drawing Tools / Inserting a Raster Image into a ReportWorks Page.

Inserting a Geo-Referenced Raster Image into a ReportWorks Page

Use the **Georaster** menu command or toolbar button to insert into a ReportWorks page a raster image that has an associated "world file" for geo-referencing its coordinates. You can adjust the image's scaling and outline. See the Raster tool for inserting generic (non-geo-referenced) raster images.

To insert the image, use your mouse to position the cursor in the page where the one corner of the image is to be placed, and click and hold the left mouse button to insert it. With the button still pressed in, drag to the location of the diagonal corner point, and release the mouse button. As you drag, you'll see a "rubber band" image of the shape's outline.

You can access the image's options at any time by double-clicking on the image or by right-clicking and choosing Properties.

You can resize the image block by first single-clicking on the image to see the boundary "handles." Then, click and hold on any of the handles on the corners or edges and drag to the new position. Release the mouse button when the boundary's edges are in the correct position. The raster image will be redrawn within the new boundary using the scaling you've selected.

Reposition the image as you wish by clicking and holding anywhere on the text and dragging it to the new location.

Help / Contents / ReportWorks / Drawing Tools / Inserting a Geo-Referenced Raster Image into a ReportWorks Page.

Inserting a Scale Bar into a ReportWorks Page

Use the **Scalebar** menu command or toolbar button to insert a scale bar on an existing ReportWorks page. You can adjust the style and scaling.

Double-click on the scale bar to access its options, or right-click and choose Properties.

You can resize the scale bar by first single-clicking on it to see its "handles." Then, click and hold on any of the handles on the corners or edges and drag to the new position. Release the mouse button when the rectangle edges are in the correct position. The program will automatically extend or shorten the bar and labels accordingly.

Reposition the entire scale bar as you wish by clicking and holding anywhere on it and dragging it to the new location.

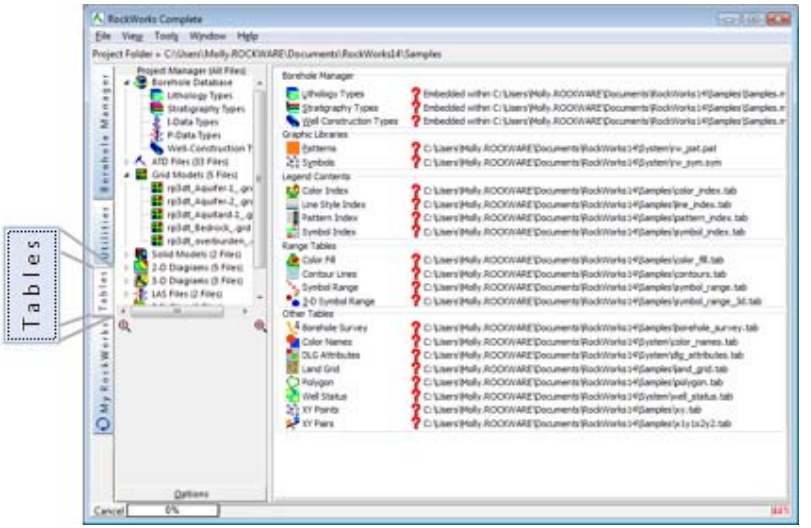
Help / Contents / ReportWorks / Drawing Tools / Inserting a Scale Bar into a ReportWorks Page.

Chapter 22 - RockWorks Tables and System Libraries

Overview

RockWorks utilizes a variety of different reference tables and libraries to perform many of its routine tasks, from plotting symbols on maps and patterns on cross sections, to looking up lithology types and polygon vertices.

To access the tables and libraries, click on the large Tables button that lies to the left of the main RockWorks window. There, you'll see a listing of a number of tables, organized by type. Just double-click on any of the listed tables to view the table's contents and make any changes.



Here is a summary of the RockWorks tables.

- Borehole Manager Type Tables: Stored in the project database (MDB).
  - **Lithology Types**: Lithology Types Tables are used in the Borehole Manager to list lithologic "keywords" and the patterns, colors, and other values to be associated with them, for lithologic logs and models (blocks, profiles, sections, fence diagrams, etc.).
  - **Stratigraphy Types**: Stratigraphy Types Tables are used in the Borehole Manager to list stratigraphic formation names and the patterns, colors, and other

values to be associated with them, for strip logs, surface maps, fence diagrams, models and more.

- **Well Construction Types**: Well Construction Types Tables list materials used in well construction columns in strip logs. They define material names, and the patterns and colors to be used to represent them in log diagrams.

- Graphic Libraries: Stored in the program's System folder (My Documents\RocWorks14\System), binary in format.
  - **Patterns**: The Pattern Table contains the RockWare pattern library, containing the graphic pattern designs used in logs and cross sections (Borehole Manager), and lease maps (RockWorks Utilities).
  - **Symbols**: The Symbol Table contains the RockWare symbol library, containing graphic symbol designs used in maps and diagrams. The symbols can be displayed in the RockWorks Utilities datasheet and in the Borehole Manager Location and Symbols tabs.

- Legend Contents: Typically stored in the project folder, ASCII (text) in format.
  - **Color Index**: Used to plot a color legend inside a map/diagram legend box in the RockPlot2D program.
  - **Line Style Index**: Used to plot a legend showing different line styles and captions inside a map/diagram legend box in the RockPlot2D program.
  - **Pattern Index**: Used to plot a legend showing different pattern designs and captions inside a map/diagram legend box in the RockPlot2D program.
  - **Symbol Index**: Used to plot a legend showing different symbol designs and captions inside a map/diagram legend box in the RockPlot2D program.

- Range Tables: Typically stored in the project folder, ASCII (text) in format.
  - **Colorfill**: A Colorfill (or color intervals) Table is used if you select Custom color intervals for 2D and 3D color-filled interval maps, and for solid block diagrams. It lists numeric value ranges and the colors that are to be used to represent those ranges in the map or diagram.
  - **Contour Lines**: Used to define a listing of Z-values and their corresponding line styles and (optionally) contour labels, to be used by the program when building 2D line contour maps for which you have requested "Custom" intervals.
  - **Symbol Range**: Used when to create proportional symbol maps (also called "bubble maps") in which the symbols in a point map are scaled in size based on a measured value at that sample location.
  - **3D Symbol Range**: Used when creating 3D symbol maps in which the spheres are scaled in sized based on a measured value at that sample location.

- Other Tables: Stored in both the project folder and system folder, ASCII (text) in format.
  - **Borehole Survey**: These tables are used by the Downhole Survey program, and list the depths, inclination, and bearing measured for the deviated well.
  - **Color Names**: These tables are used to list color names, in "regular" language (such as "red" or "blue") and their color equivalents. This prevents users from having to list long color numbers such as 16711680 in processes such as RCL.
  - **DLG Attributes**: Used by RockPlot2D to know how to plot different Digital Line Graph entities (roads vs. rivers, etc.).
  - **Land Grid**: Used in the translations of well locations or lease blocks in a Range, Township, Section format to a Cartesian-style format, and in the creation of land grid maps and lease maps.
  - **Polygon**: A Polygon Vertices Table contains a listing of X (Easting) and Y (Northing) coordinates that identify the boundary vertices of a polygonal area.
  - **Well Status**: Used by the Tobin import utility to make a association between well status and well symbol.
  - **XY Points Table**: Defines a listing of X,Y coordinate locations to be used to define the panel endpoints in a RockWorks cross section diagram.
  - **XY Pairs Table**: Defines a listing of X,Y coordinate pairs to be used to define the panel endpoints in a RockWorks fence diagram.

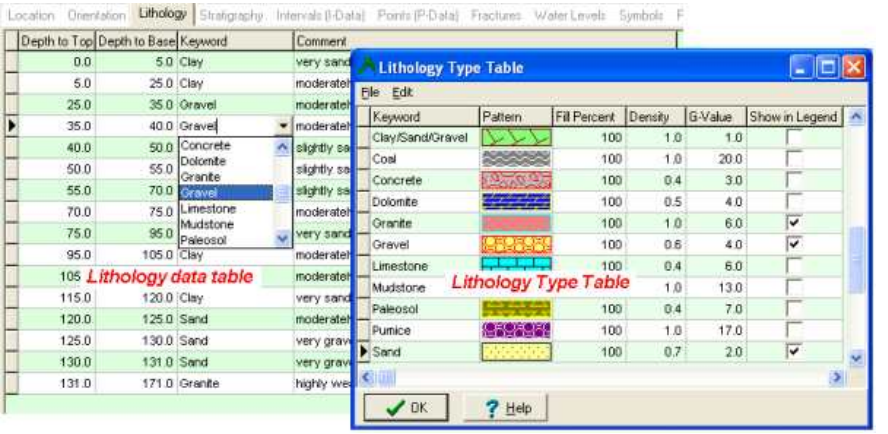
Help / Contents / RockWorks Tables & Libraries

Borehole Manager Tables

Lithology Types Tables

The Borehole Manager database uses "Lithology" data tables for entry of depth intervals and "keyword" (rock or soil type) names for each borehole. These materials can be illustrated in strip logs, and can be interpolated into a solid model for display as blocks, profiles, and more using the program's Lithology tools.

The "Lithology Types Table" defines for the program the names of the keywords for the current project's rock/material types, and the graphic pattern / color to use for each in logs and other diagrams. It serves as the reference library for the downhole lithology data. **This table is stored in the project database**.



The Lithology Types Table lists for each rock/soil material:

- The material name. This field will link to the Lithology data table.
- The pattern and colors to be used to represent the material in diagrams.
- The percent fill for the pattern (when displayed in strip logs)
- The material's density for volume/mass computations
- The "G" value, which is the numeric value to be used to represent the material in lithology models. These should be unique values for each material type.
- Whether the material is to be displayed in any diagram legends and in the pop-up list linked to the lithology data table.

! By contrast, stratigraphy (formation) names are declared in the "Stratigraphy Types Table" with borehole data listed in the RockWorks Stratigraphy data table.

! If you are importing your projects from RockWorks2002 or 2004, you can import the information from your external lithology table into the RockWorks database.

? Help / Contents / RockWorks Tables and Libraries / Lithology Types Tables:

Open the project's Lithology Types Table.

Editing the Lithology Types Table.

Measure your rock density.

Import the Lithology Types from another project database.

Import the Lithology Types from a RockWorks2002/04 Lithology Table (ASCII file).

Import a LogPlot keyword table.

Export a text version of the Lithology Types

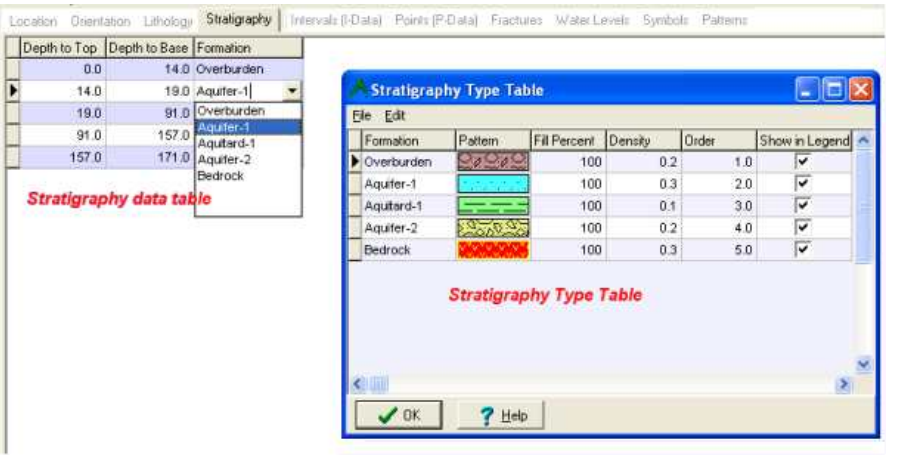
Turn off unused Lithology Types.

Change keywords to mixed/upper/lower case.

Stratigraphy Types Tables

The Borehole Manager database uses "Stratigraphy" data tables for entry of depth intervals and formation layer names for each borehole. These formations can be illustrated in strip logs, as surface maps, fence diagrams, and more using the program's Stratigraphy tools.

The "Stratigraphy Types Table" defines for the program the names of the formations for the current project, and the graphic pattern / color to use for each formation in logs and other diagrams. It serves as the reference library for the downhole stratigraphic data. **This table is stored in the project database**.



The Stratigraphy Types Table lists for each formation:

- The formation name. This field will link to the data table.
- The pattern and colors to be used to represent the formation in diagrams.
- The percent fill for the pattern (when displayed in strip logs)
- The formation density for volume/mass computations
- The formation's order, from the ground downward. (This "G" value will also be assigned for that layer in stratigraphic solid models, should you decide to save them.)
- Whether the formation is to be displayed in any diagram legends and in the pop-up list linked to the stratigraphy data tables.

! By contrast, observed lithology names are declared in the "Lithology Types Table," with borehole lithologies listed in the RockWorks Lithology data table.

! If you are importing your projects from RockWorks2002 or 2004, you can import the information from your external stratigraphy table into the RockWorks database.

? Help / Contents / RockWorks Tables and Libraries / Stratigraphy Types Tables:

Open the project's Stratigraphy Types Table.

Editing the Stratigraphy Types Table.

Measure your rock density.

Import the Stratigraphy Types from another project database.

Import the Stratigraphy Types from a RockWorks2002/04 Stratigraphy Table (ASCII file).

Import a LogPlot keyword table.

Export a text version of the Stratigraphy Types

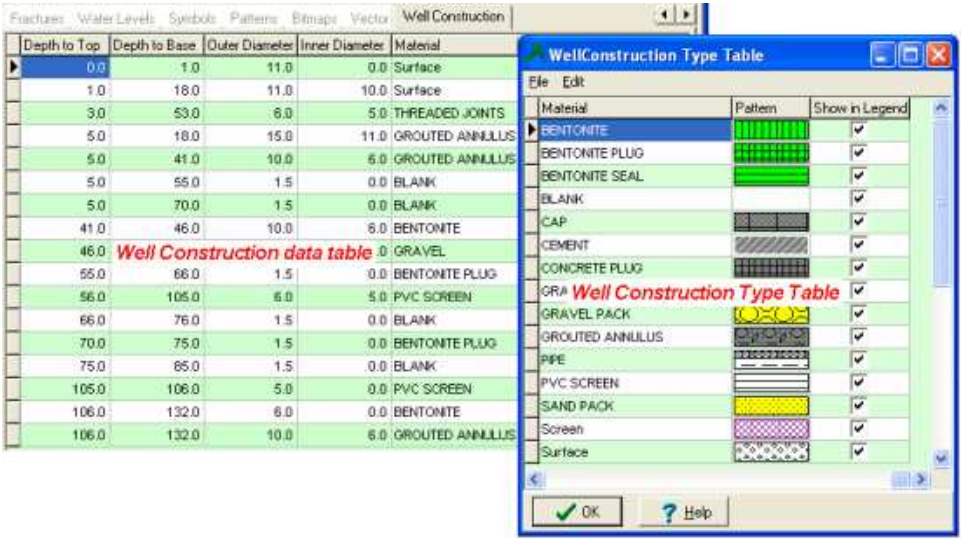
Turn off unused Stratigraphy Types.

Change formation names to mixed/upper/lower case.

Well Construction Types Tables

The Borehole Manager database uses "Well Construction" data tables for entry of depth intervals and different material types for construction information for each borehole. This information can be illustrated in strip logs and log sections.

The "Well Construction Types Table" defines for the program the names of the construction materials for the current project, and the graphic pattern / color to use for each material type. **This table is stored in the project database**.



The Well Construction Types Table lists for each material:

- The material name, such as "casing" or "screen". This field will link to the data table.
- The pattern and colors to be used to represent the material in log diagrams.
- Whether the material is to be displayed in any diagram legends.

Help / Contents / RockWorks Tables and Libraries / Well Construction Types Tables:

Open the project's Well Construction Types Table.
Editing the Well Construction Types Table.
Import the Well Construction Types from another project database.
Import the Well Construction Types from an ASCII file.
Import a LogPlot keyword table.
Export a text version of the Well Construction Types
Turn off unused Well Construction Types.
Change material names to mixed/upper/lower case.

Graphic Libraries

Pattern Tables

Pattern Tables Overview

Patterns are repeating graphic units that can be associated with some kind of data item, such as lithology keywords in the Borehole Manager's Lithology tab, or formation names in the Stratigraphy tab. The actual pattern <-> data associations are made within the Lithology Types Table (for lithology) and the Stratigraphy Types Table (for stratigraphy).

RockWorks is shipped with a large number of patterns already installed, in a "Pattern Table." The factory default Pattern Table is named "RW_pat.pat". It is stored in the "System" folder in your “My Documents\RockWorks14”folder. Unlike some of the other program tables (*.TAB files), this table is binary rather than ASCII in format.

To access the Pattern Table, where you can view the current pattern set, open a new pattern set, or even access the Pattern Editor where you can modify existing patterns or create new patterns, follow these steps:

1. Click on the large Tables button along the left edge of the main RockWorks program window.
2. Click on the file name to the right of the Patterns row heading.

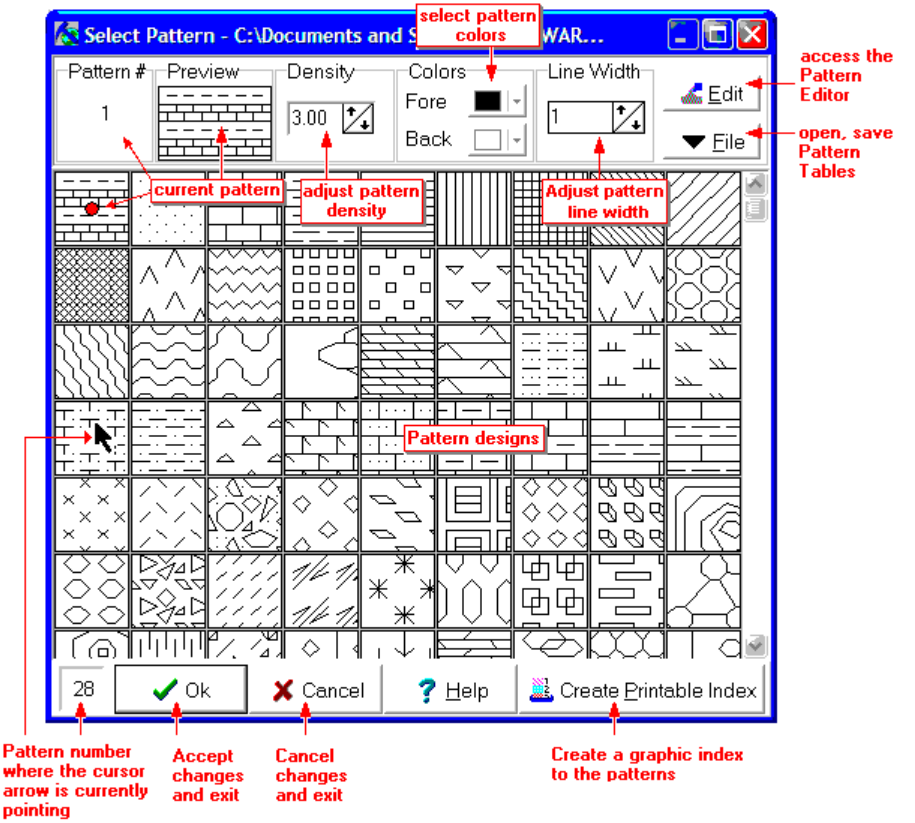
The program will display the default Pattern Table in the Select Pattern window. Here you can view and select patterns from the current pattern library. It also lets you access the Pattern Editor where you can edit existing pattern designs and create new patterns. See the topics below.

(The Pattern Table can also be accessed from several other places within the program: the Stratigraphy Types Table, Lithology Table, the Borehole Manager Stratigraphy and Lithology data tabs, the RockWorks Utilities datasheet if you double-click on a pattern data column.)

The Select Pattern Window

The Select Pattern window displays all of the pattern designs contained in the current Pattern Table. The factory default Table is "RW_pat.pat" (in the "My Documents\RockWorks14\System" folder). If you do a lot of modifications to this file, or like to maintain specific pattern libraries for different projects, you can save the Pattern Table under different file names and in different folders. The name of the current Table is displayed at the top of the Select Pattern window.

This window is used to view patterns, select pattern colors and density, open other Pattern Tables, and access the Pattern Editor.



1. To view pattern samples that are not currently visible, drag the scroll bars up or down as appropriate.

Help / Contents / RockWorks Tables and Libraries / Pattern Tables

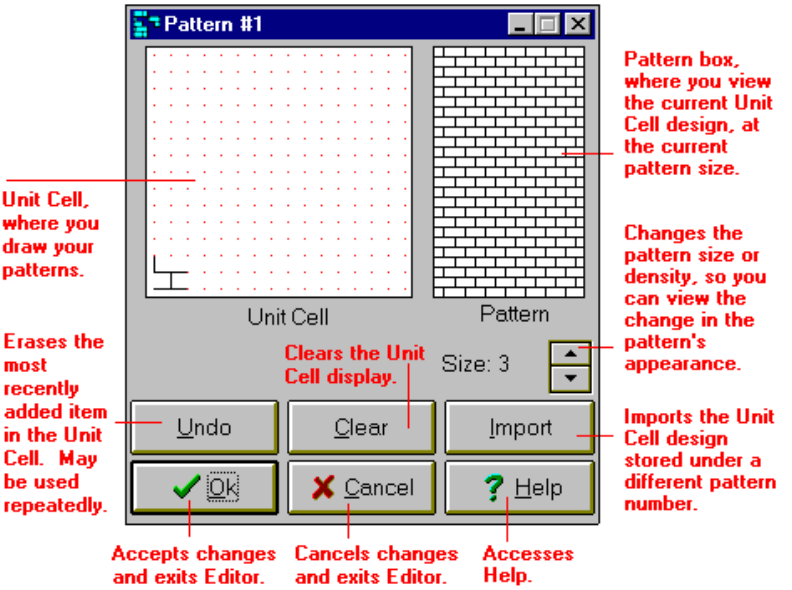
View the index number for a pattern design.
Select a pattern to be active.

Adjust the pattern density.
Select pattern colors.
Open a different Pattern Table.
Save the current Pattern Table under a new name.
Create a printable index to the current Table.
Access the Pattern Editor.

Using the Pattern Editor

The Pattern Editor is a tool that permits you to edit an existing pattern design or create a new pattern design for use to illustrate rock types in logs, cross sections, etc. Pattern designs are stored in a RockWorks "Pattern Table."

The Pattern Editor is accessed from the Select Pattern window. The selected pattern design (or blank pattern) will be displayed in the Pattern Editor.


Pattern #1
Unit Cell
Pattern
Size: 3
Undo
Clear
Import
Ok
Cancel
Help
Pattern box, where you view the current Unit Cell design, at the current pattern size.
Unit Cell, where you draw your patterns.
Changes the pattern size or density, so you can view the change in the pattern's appearance.
Erases the most recently added item in the Unit Cell. May be used repeatedly.
Clears the Unit Cell display.
Imports the Unit Cell design stored under a different pattern number.
Accepts changes and exits Editor.
Cancels changes and exits Editor.
Accesses Help.

Help / Contents / RockWorks Tables and Libraries / Pattern Tables

Creating new patterns.
Importing existing patterns.
Editing existing patterns.
Drawing patterns.
Understanding the pattern origin.
Viewing pattern sizes.
Exiting the Pattern Editor.

Symbol Tables

Symbol Tables Overview

Symbols are small line drawings that can be associated with each record (row) in the RockWorks Utilities data window, representing a different sample site or drill hole location. The symbols will be used by the program to note the sample locations in point maps, ternary diagrams, stereonets, etc. Symbols will also be associated with each borehole in the Borehole Manager (shown on the Location tab).

RockWorks is shipped with an existing set of symbols already installed, in a "Symbol Table." The factory default symbol Table is named "RW_sym.sym". It is installed in the My Documents\RockWorks14\System folder. Unlike some of the other program tables (*.TAB files), this table is binary rather than ASCII in format.

To access the Symbol Table, where you can view the current symbol set, open a new symbol library, or even access the Symbol Editor where you can modify existing symbols or create new ones, follow these steps:

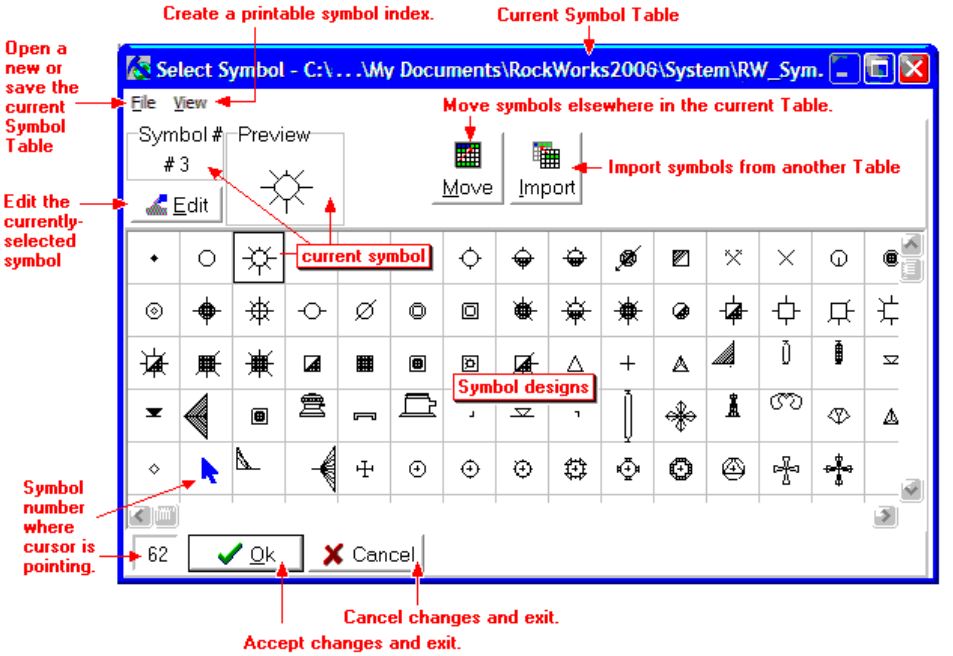
1. Click on the large Tables button along the left edge of the main RockWorks program window. *
2. Click on the name listed to the right of the Symbols row heading. The program will display the default Symbol Table in the Select Symbol window.

Here you can view and select symbols from the current symbol library. It also lets you access the Symbol Editor where you can edit existing symbol designs and create new symbols. See the topics below.

* The Symbol Table can also be accessed from within the RockWorks Utilities data sheet, by double-clicking on a graphic symbol cell. It can also be accessed by clicking on the picture of the symbol in the Borehole Manager Location tab.

Using the Select Symbol Window

The Select Symbol window displays all of the symbol designs in the current Symbol Table. The factory default Table is "RW_sym.sym" (in the "My Documents\RockWorks2006\System" folder). This window is used to view symbols, select symbol colors, open other Symbol Tables, and access the Symbol Editor.



To view symbol samples that are not currently visible, drag the scroll bars up or down as necessary.

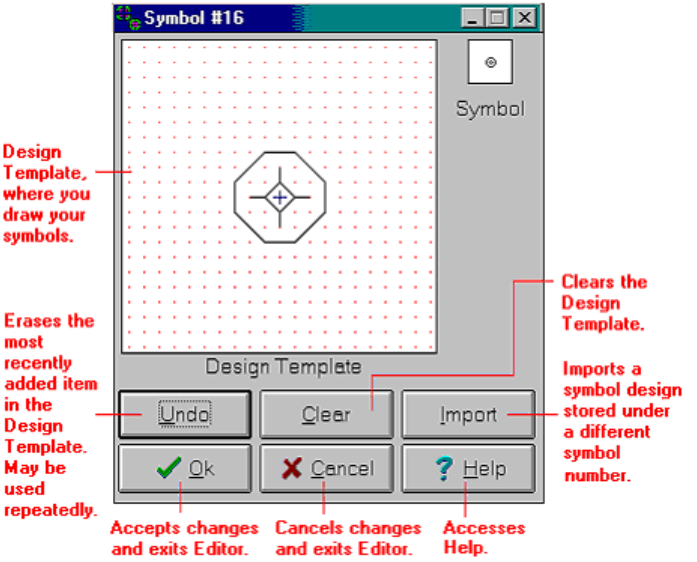
Help / Contents / RockWorks Tables and Libraries / Symbol Tables

View the index number for a symbol.
Select a symbol to be active.
Move symbols within the table.
Import symbols from another Symbol Table.
Open a different Symbol Table.
Save the current Symbol Table under a new name.
Create a printable index to the current Table.
Access the Symbol Editor.

Using the Symbol Editor

The Symbol Editor is a tool that permits you to edit an existing symbol design or create a new symbol design for use to illustrate sample locations in maps, stereonets, etc. Symbol designs are stored in a RockWorks "Symbol Table."

The Symbol Editor is accessed from the Select Symbol window. The selected symbol design (or blank symbol) will be displayed in the Symbol Editor.



(* The Select Symbol window can also be accessed by double-clicking in a symbol column in the RockWorks Utilities data sheet or by clicking on the symbol picture in the Borehole Manager Location tab.)

Help / Contents / RockWorks Tables and Libraries / Symbol Tables

Create a new symbol.
Import existing symbols.
Edit existing symbols.
Draw symbols.
Exit the Symbol Editor.

Diagram Legend Tables

Color Index Tables

A "Color Index Table" is used to plot a color legend inside a map/diagram legend box in the RockPlot2D program. (These RockPlot2D legends can also include line style legends, pattern legends, and symbol legends, described in following topics.) Although many RockWorks color diagrams (maps, stratigraphic blocks, etc.) offer automatic color legends, it can be handy to include a custom color index in an overall diagram legend to emphasize anomalous areas, etc. Color Index legends can also be inserted into ReportWorks layouts.

The factory default Color Index Table is named "color_index.tab", installed with the Samples dataset (My Documents\RockWorks14\Samples folder). This table is ASCII in format.

! Since these tables are generally project-specific, we recommend that you store your working table in the project folder.

Help / Contents / RockWorks Tables and Libraries / Color Index Tables.

See also: Colorfill Tables (page 264).

Line Style Index Tables

A "Line Style Index Table" is used to plot a legend showing different line styles and captions inside a map/diagram legend in the RockPlot2D program.

The factory default Line Style Index Table is named "line_index.tab", installed with the Samples dataset (My Documents\RockWorks14\Samples folder). This table is ASCII in format.

! Since these tables are generally project-specific, we recommend that you store your working table in the project folder.

Help / Contents / RockWorks Tables and Libraries / Line Style Index Tables.

Pattern Index Tables

A "Pattern Index Table" is used to plot a legend showing different pattern designs and captions inside a map/diagram legend box in the RockPlot2D program. (These RockPlot2D legends can also include color legends, line style legends, and symbol legends, described in previous and following topics.) Pattern Index legends can also be inserted into ReportWorks layouts.

The factory default Pattern Index Table is named "pattern_index.tab", installed with the Samples dataset (My Documents\RockWorks14\Samples folder). This table is ASCII in format.

! Since these tables are generally project-specific, we recommend that you store your working table in the project folder.

Help / Contents / RockWorks Tables and Libraries / Pattern Index Tables.

See also: Pattern Tables (page 257).

Symbol Index Tables

A "Symbol Index Table" is used to plot a legend showing different map symbol designs and captions inside a map/diagram legend box in the RockPlot2D program. (These RockPlot2D legends can also include color legends, line style legends, and pattern

legends, described in previous topics.) Symbol Index legends can also be inserted into ReportWorks layouts.

The factory default Symbol Index Table is named "symbol_index.tab", installed with the Samples dataset (My Documents\RockWorks14\Samples folder). This table is ASCII in format.

! Since these tables are generally project-specific, we recommend that you store your working table in the project folder.

Help / Contents / RockWorks Tables and Libraries / Symbol Index.

See also: Symbol Tables (page 260).

Range Lookup Tables

Colorfill Tables

A "Colorfill Table" is used to define a listing of value intervals and their corresponding colors, to be used by the program when building 2D or 3D color-filled contour maps, solid models, etc. for which you have requested "Custom" color intervals. They can also be used to display a reference color index in RockPlot2D and ReportWorks.

The default Colorfill Table is named "color_fill.tab", installed with the Samples dataset (My Documents\RockWorks14\Samples folder). This table is ASCII in format.

! Since these tables are generally project-specific, we recommend that you store your working table in the project folder.

Help / Contents / RockWorks Tables and Libraries / Colorfill Tables.

See also: Color Index Tables (page 262).

Contour Tables

A "Contour Table" is used to define a listing of Z-values and their corresponding line styles and (optionally) contour labels, to be used by the program when building 2D line contour maps for which you have requested "Custom" intervals.

The factory default Contour Table is named "contours.tab". It is installed into the \My Documents\RockWorks14\Samples folder. This table is ASCII in format.

! Since these tables are generally project-specific, we recommend that you store your working table in the project folder.

Help / Contents / RockWorks Tables and Libraries / Contour Tables.

Symbol Range Tables

All of the point-mapping tools in the RockWorks Utilities (Map / EZ Map, etc.) offer variable scaling of symbols. This means that the size of the symbols can vary across the map or diagram, based on the quantitative value measured at each sample site. With this scheme, you can declare actual symbol sizes for as many z-value ranges as you wish, using a "Symbol Range Table." Once you have a Symbol Range Table set up, you can save it for later use. You can also load an existing table that you have saved on disk.

The program is shipped with a default Symbol Range Table called "symbol_range.tab", installed with the Samples dataset (My Documents\RockWorks14\Samples folder). This table is ASCII in format.

! Since these tables are generally project-specific, we recommend that you store your working table in the project folder.

Help / Contents / RockWorks Tables and Libraries / Symbol Range Tables.

Other Tables

Borehole Survey Tables

Borehole Survey Tables are read by the RockWorks Utilities **Survey** / **Drill Hole Survey** program. These tables list the depth, direction, and inclination of the deviated borehole whose XYZ coordinates and log display the Survey program is designed to compute. These tables conform to the same data format as the Borehole Manager's Orientation data tabs.

The default Borehole Survey Table is named “borehole_survey.tab” and is installed with the program's samples in the My Documents\RockWorks14\Samples folder.

Help / Contents / RockWorks Tables and Libraries / Borehole Survey Tables.

Color Names Tables

The Color Names table is used to define a listing of color "words" (such as "red" or "bright_green") and their corresponding colors. These definitions are used within AGL (ASCII Graphics Language) files which can be imported into RockPlot2D to generate a graphic image. The color names replace the former RGB values.

The factory default Color Table is named "Color_names.tab", installed into the program's System folder (My Documents\RockWorks14\System). This table is ASCII in format. Since these tables apply system-wide, we recommend that you store this table in the program's System folder.

Help / Contents / RockWorks Tables and Libraries / Color Names Tables.

DLG Attributes Table

RockPlot2D (the RockWorks plotting program) offers import of USGS Digital Line Graph ("DLG") data extracted from 1:100,000 or 1:2,000,000-scale maps, Optional format. Boundary, transportation, hydrography, hypsography (contour) and land grid categories are supported. The SDTS format is not currently supported.

In order to know how to plot the different DLG entities (roads vs. rivers, etc.), the program uses the information stored in the "DLG Attribute Table." This Table lists different DLG entity types, plus the line style, thickness, and color to be used to plot them.

The factory default DLG Attributes Table is named "dlg_attributes.tab". It is stored in the My Documents\RockWorks14\System folder. This table is ASCII in format.

! Since these tables are not project-specific, we recommend that you store your working table in the RockWorks system folder, shown above.

? Help / Contents / RockWorks Tables and Libraries / DLG Attributes Table.

? Help / Contents / RockPlot2D / Importing Plot Files / Importing Digital Line Graph (DLG) files.

Land Grid Tables

Land Grid Tables Overview

Land Grid Tables contain a listing of Jeffersonian-style locations, in Range, Township, Section (RTS) notation, and the longitude and latitude reference coordinates for the section corners. These tables are used by several tools in RockWorks:

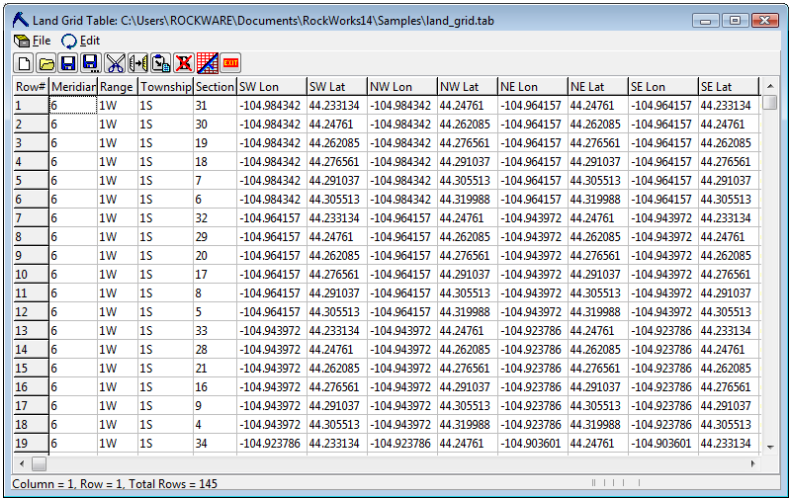
- Borehole Manager **Map** menu, **Adjust Coordinates** / **Jeffersonian -> Easting/Northing**: This tool translates well locations from RTS format to the required Easting and Northing format.
- RockWorks Utilities **Coords** menu, **Jeffersonian Points -> Cartesian** and **Jeffersonian Polygons -> Cartesian**: These tools translate RTS locations to X,Y coordinates in lon/lat or Easting/Northing format.
- RockWorks Utilities **Map** menu, **Land Grid** / **Section Map** and **Lease Map**: These tools create section boundary maps and lease maps.

Where do these reference coordinates come from? RockWorks offers two options:

1. One option is to purchase RTS land grid information from a commercial source. This requires that you import that data into the Land Grid Table. (See Importing Commercial Land Grid Data for details.)
2. The second option is to create an idealized land grid, which requires only that you define a single known latitude and longitude coordinate for a corner of a Township and the number of townships to be listed. (See Interpolating Idealized Land Grid Data for details.)

! IMPORTANT: Although we ship a sample Land Grid Table with the program, you will need to create (import or interpolate) your own land grid table for your own projects

Below is an example of how a Land Grid Table would look when the data is imported or interpolated.



Land Grid Table: C:\Users\ROCKWARE\Documents\RockWorks14\Samples\land_grid.tab

File Edit

Row#	Meridian	Range	Township	Section	SW Lon	SW Lat	NW Lon	NW Lat	NE Lon	NE Lat	SE Lon	SE Lat
1	6	1W	1S	31	-104.984342	44.233134	-104.984342	44.24761	-104.964157	44.24761	-104.964157	44.233134
2	6	1W	1S	30	-104.984342	44.24761	-104.984342	44.262085	-104.964157	44.262085	-104.964157	44.24761
3	6	1W	1S	19	-104.984342	44.262085	-104.984342	44.276561	-104.964157	44.276561	-104.964157	44.262085
4	6	1W	1S	18	-104.984342	44.276561	-104.984342	44.291037	-104.964157	44.291037	-104.964157	44.276561
5	6	1W	1S	7	-104.984342	44.291037	-104.984342	44.305513	-104.964157	44.305513	-104.964157	44.291037
6	6	1W	1S	6	-104.984342	44.305513	-104.984342	44.319988	-104.964157	44.319988	-104.964157	44.305513
7	6	1W	1S	32	-104.964157	44.233134	-104.964157	44.24761	-104.943972	44.24761	-104.943972	44.233134
8	6	1W	1S	29	-104.964157	44.24761	-104.964157	44.262085	-104.943972	44.262085	-104.943972	44.24761
9	6	1W	1S	20	-104.964157	44.262085	-104.964157	44.276561	-104.943972	44.276561	-104.943972	44.262085
10	6	1W	1S	17	-104.964157	44.276561	-104.964157	44.291037	-104.943972	44.291037	-104.943972	44.276561
11	6	1W	1S	8	-104.964157	44.291037	-104.964157	44.305513	-104.943972	44.305513	-104.943972	44.291037
12	6	1W	1S	5	-104.964157	44.305513	-104.964157	44.319988	-104.943972	44.319988	-104.943972	44.305513
13	6	1W	1S	33	-104.943972	44.233134	-104.943972	44.24761	-104.923786	44.24761	-104.923786	44.233134
14	6	1W	1S	28	-104.943972	44.24761	-104.943972	44.262085	-104.923786	44.262085	-104.923786	44.24761
15	6	1W	1S	21	-104.943972	44.262085	-104.943972	44.276561	-104.923786	44.276561	-104.923786	44.262085
16	6	1W	1S	16	-104.943972	44.276561	-104.943972	44.291037	-104.923786	44.291037	-104.923786	44.276561
17	6	1W	1S	9	-104.943972	44.291037	-104.943972	44.305513	-104.923786	44.305513	-104.923786	44.291037
18	6	1W	1S	4	-104.943972	44.305513	-104.943972	44.319988	-104.923786	44.319988	-104.923786	44.305513
19	6	1W	1S	34	-104.923786	44.233134	-104.923786	44.24761	-104.903601	44.24761	-104.903601	44.233134

Column = 1, Row = 1, Total Rows = 145

- Each row contains data for a single Section.
- The Sections do not need to be listed in any particular order.
- If Sections are missing from Township, they simply will not be plotted on the final map.
- No blank cells are permitted. If there is data missing for a particular Section, the entire row should be removed.

! There is a distinction in how RockWorks will use the four "standard" corner points, and the "stream" points in column 14.

The four corner points will be used when plotting township boundaries in section maps (RockWorks Utilities Map / Land Grid / Section Map) and when spotting wells (using the RockWorks Utilities Coords / Jeffersonian Points -> Cartesian or Jeffersonian Polygons -> Cartesian options, or the Borehole Manager Map / Adjust Coordinates / Jeffersonian -> Easting/Northing option). If you imported commercial land grid data that has more points defined for a Section, this program will pick the four best points possible to use for corners.

The Points and Point Stream columns will be used when creating section maps (using the RockWorks Utilities Map / Land Grid / Section Map tool).

See also: Land Grid Maps (page 113), RockWare Landbase (page 270).

Importing Commercial Land Grid Data

If you have purchased land grid data from a commercial vendor and wish to use this data as a means of spotting wells or leases and/or for creating section or lease maps, this data must be imported into the RockWorks Land Grid Table. This import tool can read data provided by these commercial vendors:

* Petroleum Information / Dwights * TMC * Tobin * White Star

Because the native format of these files is not consistent with the RockWorks Land Grid Table, these commercial files must be imported into the table prior to mapping, well spotting, etc.

If you have not purchased commercial data, see Creating Idealized Land Grids.

? Help / Contents / RockWorks Tables and Libraries / Land Grid Tables / Importing Commercial Land Grid Data.

Interpolating an Idealized Land Grid

If you do not have commercially-available land grid data, it is still possible to create an "idealized" land grid for mapping or well spotting, given a user-defined longitude and latitude coordinate. We certainly don't live in a perfect world, however, so be advised of these assumptions and limitations with interpolated land grids:

* The program will create data for *entire* Townships of 36 *square* Sections each. Partial Townships and irregular Sections are not possible.
* It will base its coordinate assignments on the longitude and latitude coordinates you declare for a specific land grid point.

If you have purchased commercial data, see Importing Commercial Land Grid Data.

? Help / Contents / RockWorks Tables and Libraries / Land Grid Tables / Interpolating an Idealized Land Grid.

Polygon Vertices Tables

A Polygon Vertices Table contains a listing of X (Easting) and Y (Northing) coordinates that identify the boundary vertices of a polygonal area. In RockWorks, you can use this polygon to filter grid values (**Grid** / **Filter**), solid model values (**Solid** / **Filter**), and more.

The program is shipped with a default Polygon File called "PolyClip.tab" in the My Documents\RockWorks14\System folder. This file is ASCII in format.

! The Polygon Vertices table also contains a digitizing tool for digitizing the X, Y vertices right into the table, using an electronic digitizer. See Digitizing Data (page 98) for details. See the Help topic for a detailed step-by-step for digitizing and capturing the polygon coordinates.

? Help / Contents / RockWorks Tables and Libraries / Polygon Vertices Tables.

Well Status Tables

A "Well Status Table" contains a list of well status terms/acronyms (e.g. O&G, D&A, DRY, etc.) and the map symbols that are associated with these acronyms. The Well Status Table is used by the Tobin WCS import tools for the RockWorks Utilities and Borehole Manager, and by the IHS data importer in the Borehole Manager. It is used to assign a symbol design to each well automatically, based on the status term listed for the well in the input file.

The default Well Status Table is named “well_status.tab” and is installed with the program's tables in the My Documents\RockWorks14\System folder.

Help / Contents / RockWorks Tables and Libraries / Well Status Tables.

X,Y Points Tables

An "XY Points" table is used to define a listing of X,Y coordinate locations to be used to define the panel endpoints in a RockWorks cross section diagram. While you can interactively draw cross section traces, the program also allows you to specify a coordinate listing such as this, should you wish precise locations or run the program in command (RCL) mode.

The factory default XY Points Table is named "XY.tab". It is stored with the program's tables in the My Documents\ RockWorks14\System folder. This table is ASCII in format.

Help / Contents / RockWorks Tables and Libraries / XY Points Tables.

X,Y Pairs Tables

An "XY Pairs" table is used to define a listing of X,Y coordinate locations to be used to define the panel endpoints in a RockWorks fence diagram. Though you can interactively draw fence panel locations, the program also allows you to specify a coordinate listing such as this, should you wish precise locations or run the program in command (RCL) mode.

The factory default XY Pairs Table is named "X1Y1X2Y2.tab". It is stored with the program's tables in the My Documents\ RockWorks14\System folder. This table is ASCII in format.

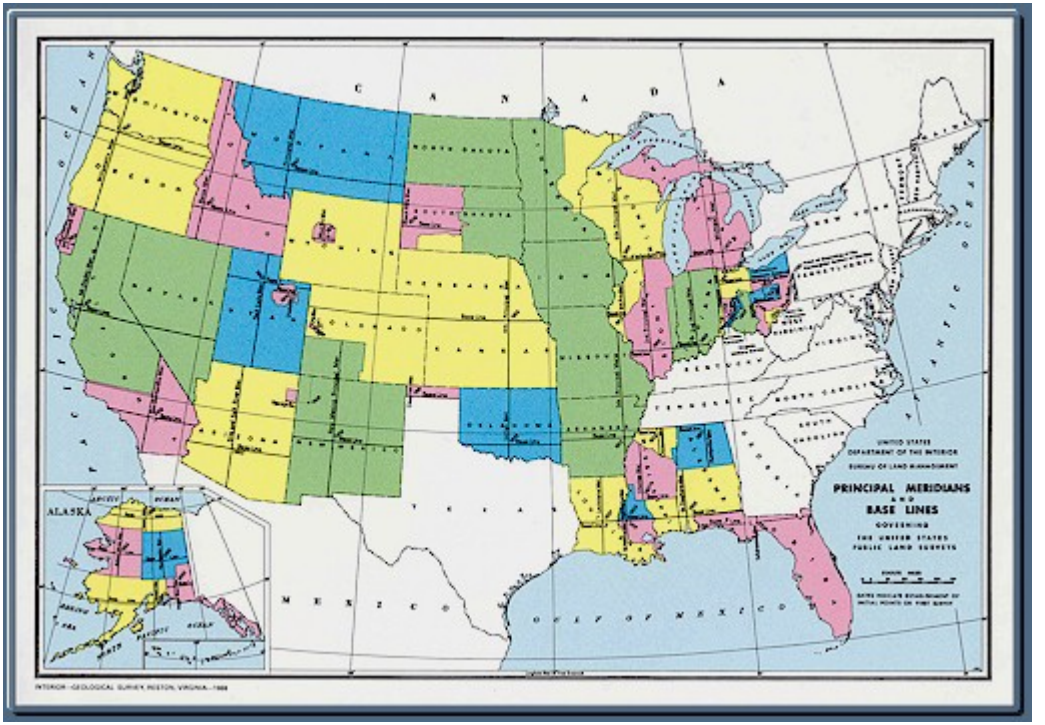
See Help / Contents / RockWorks Tables and Libraries / XY Pairs Tables.

RockWare Landbase

The RockWare Landbase contains section coordinates for selected range and township surveys from data that was downloaded, concatenated, and reformatted from a variety of public sources (US BLM, state geological surveys, etc.) The Landbase data can be used to spot wells and leases, and to generate maps representing section lines.

The Landbase files are downloaded to the My Documents\ RockWorks14\System folder using the Help / Download / RockWare Landbase link.

The program doesn't offer any means of viewing or editing the Landbase data, but you can access a reference map showing the Principal Meridians and Range/Township coverages (shown below) from within the RockWorks Utilities Map / Land Grid Maps options, the Coords / Jeffersonian Points and Jeffersonian Polygons option, and the Borehole Manaer's Map / Adjust Coordinates / Jeffersonian -> Easting/Northing option.



See Help / Contents / RockWorks Tables and Libraries / RockWare Landbase.

Chapter 23 - Reference

Summary of RockWorks File Types

The following is a list of the file types used in RockWorks.

User-Created Data Files

ATD: "ATD" files are user-created data files used in the RockWorks Utilities datasheet for storing row and column data. They can contain rows and columns of text, numeric values, symbols, color, line styles, and more. In RockWorks the column titles and column types are stored in a set of header lines at the top of the file. ATD files are ASCII Tab-delimited in format. File name extension = [.atd]. See RockWorks Utilities Datasheet Overview (page 73) and ATD File Structure Overview (in the Help messages Reference section) for more information.

MDB: This is a Microsoft Access-compatible database file that is generated by RockWorks automatically when you create a new project folder. It stores all of the borehole data for the project, many of the “type” libraries (lithology, stratigraphy, i-data, etc.), and the project dimensions. The database file name must match the folder name; for example the MDB file in the "Golden Project" folder will be named "Golden Project.mdb". File name extension = [.mdb]. The database will create support files, such as XML data "dictionaries" in the program folder. See Borehole Data Overview (page 30) and the “Borehole Manager” section of the Help messages for more information.

BH: "BH" files are user-created data files used in the Borehole Manager in RockWorks2004 and 2002. These can be imported into the RockWorks MDB database using the File / Import / RockWorks2002/2004 menu option. See page 54 for more information.

RCL: "RCL" files are created by the user outside the RockWorks program in a text editor. These files contain a series of commands used to run RockWorks in a batch mode. "RCL" stands for "RockWare Command Language." See Using the RockWare Command Language (page 304) and RCL Format (Help / Contents / Reference / RCL Scripting) for information.

Program-Created Model Files

GRD: "Grid" files are created by RockWorks as the result of gridding X,Y,Z data in the RockWorks Utilities, or of gridding formation, thickness, water level or other spatial data in the Borehole Manager. Grid files can also be the result of filtering or importing existing grid files. Grid files are ASCII in format, with the file name extension [.grd]. See Gridding Reference and RockWorks Grid File Format in the Help message Reference.

MOD: "Solid Model" files are created by RockWorks as the result of modeling X,Y,Z,G data in the RockWorks Utilities, or of modeling lithology, interval-data, point-data, or

fracture data in the Borehole Manager. In addition, stratigraphic surface models can be stacked and saved as a solid model file. They can also be the result of filtering or importing existing solid models. They are ASCII in format, with the file name extension [.mod]. See Solid Modeling Reference and RockWorks Solid Model Format in the Help message Reference section.

Program-Created Plot Files

RK6: These "plot" files are created in the RockPlot2D window to store all RockWorks2D graphic images (2D maps and logs, rose and stereonet diagrams, etc.). They are binary in nature, and use the file name extension [.rk6]. See Managing RockPlot2D Files (page 209).

R3DXML: This is the newest, default plot file format for files created in the RockPlot3D window to store the information in a 3-dimensional graphic image (3D surfaces and logs, solid models, fence panels, etc.). These are ASCII in format and contain links to solid models, bitmap images, etc. that may be displayed in the RockPlot3D view. The file name extension is [.r3dxml]. See Managing R3DXML Files (page 225). (These files are XML in format; the 6-character file name extension allows RockWare to register this file type within Windows.)

RW6: These are graphic files created by the ReportWorks program, storing the page layout of inserted RK6 images, bitmaps, text, shapes, and more. They are binary in format. The filename extension is [.rw6]. See Managing ReportWorks Files (page 242).

Program Libraries

PAT: These are Pattern Tables that contain the designs for repeating graphic patterns used in logs, cross sections, lease maps, etc. RockWorks is shipped with a library of patterns in the default "rw_pat.pat" table; you can save this file under a different name, delete patterns, add pattern designs, etc, via the tables listing accessed using the large Tables button along the left edge of the main RockWorks program window. Pattern files are binary in format, with the file name extension [.pat]. See Pattern Tables Overview (page 257).

SYM: These are Symbol Tables that contain the designs for graphic symbols used in maps, statistical diagrams, logs, etc. RockWorks is shipped with a library of symbols in the default "rw_sym.sym" table; you can save this file under a different name, delete symbols, add symbol designs, etc, via the tables listing accessed using the large Tables button along the left edge of the main RockWorks program window. Symbol files are binary in format, with the file name extension [.sym]. See Symbol Tables (page 260).

TAB: These are user-created Tables that can be used in a variety of places in RockWorks: to define a polygonal area for filtering a grid model, to define specific Z value ranges for color contour maps, etc. The list of RockWorks Tables can be found by clicking the large Tables button along the left edge of the main RockWorks program window. (The program

is shipped with a library of these tables which can be edited to suit your own data.) These files are ASCII in format, and have the file name extension [.tab]. See Chapter 22.

01 – 06: These rockware_landbase files contain Range/Township/Section coordinates for portions of the United States. These files are not installed with the program (they're large) but can be downloaded from the RockWare web site using the link in the RockWorks Help / Download / RockWare Landbase menu item. These data are used by the RockWorks Utilities Map / Land Grid Maps tools, Coords / Jeffersonian Points & Polygons tools, and the Borehole Manager Map / Adjust Coordinates / Jeffersonian tool.

Importable, Exported Files

	Import	Export
Borehole Manager (data)	ASCII, Excel, gINT, HIS, LAS, LogPlot DAT, Colog, Spectrum Cone Penetrometer, RockWorks99 ATD/TEM, RockWorks 2002/2004 BH, Tobin WCS	ASCII, Excel, ASCII XYZG, LogPlot DAT, RockWorks2002/2004 BH.
RockWorks Utilities (data)	Excel, ASCII, DBF, Delorme GPL, DXF line endpoints, DXF XYZ, Garmin Txt, Geonics EM38, GSM Magnetometer/Gradiometer, Laser Atlanta surveys, Modpath particle flowpaths, NEIC Earthquakes, SEG-P1 shotpoints, Tobin WCS, Land grids (PI/Dwights, Tobin, Platte River),	ASCII, DBF, Excel
Grid	Surfer binary or ASCII, ESRI ASCII grid, Geosoft GXF, RockWorks DOS/7, ASCII, Bitmaps, DEM	ASCII XYZ or matrix, DXF matrix, ESRI ASCII Grid, Geosoft GXF, Ohio Automation ENZ, RockWare RTM, RockWorks DOS/7, Surfer ASCII & binary, Vistapro
Solid models	ASCII	ASCII, NOeSYS, Slicer Dicer, Voxel Analyst
RockPlot2D	BMP, JPG, PNG, TIFF, WMF, EMF, TGA, PCX, DXF, ESRI E00, ESRI Shapefiles, DLG, AGL	BMP, JPG, KMZ, PNG, TIFF, DXF, WMF, EMF, RockPlot3D
RockPlot3D	DXF	BMP, JPG, PNG, TIFF, AVI, ESRI Shapefile
ReportWorks	BMP, JPG, TIFF, and World files	BMP, JPG, PNG

Help / Contents / Reference / File Formats.

Program Preferences

The **Tools** / **General Preferences** option is used to establish some general operational settings for the RockWorks program. This option is available from both the RockWorks Utilities and Borehole Manager, via the **Tools** menu.

Skip Introductory Screen: Insert a check in this box if you want to hide the introductory "welcome" screen that's displayed when you start up RockWorks. This box should be un-checked if the splash screen is to be displayed. Changes will not take effect until the next time you start the program. This setting can also be adjusted on the startup screen itself.

Display Project Manager: Insert a check here to display a list of files in the current project folder along the left edge of the program window. There is a sub-option for displaying graphic file previews as you hover the mouse over the file name.

Load Last-Used ATD File into Utilities Datasheet On Startup: Insert a check here if the program is to load into the Utilities data window, automatically on startup, the last datasheet with which you were working.

Prompt for Project Folder: Insert a check in this box to be prompted, each time the program is launched, for the name of the folder in which you wish to work. The prompt will default to the last folder in which you were working or, if you're new to the program, the tutorial samples folder. If you prefer not to see this prompt when you start up the program, remove the check from this box. Note that you can change the current Project Folder at any time while you are working with the program simply by clicking in the Project Folder prompt below the main menu items.

Reminders: Insert a check-mark for the program to display a "Do-you-want-to-save?" reminder when you close a RockPlot2D graphics window and the image has not been saved. We recommend that you leave this setting on.

Check for Newer Version On Startup: Insert a check here to have RockWorks check whether there's a new version on the RockWare web site and display an alert if there is. If desired, you can be directed to RockWare's download site where you can save the latest installation program to your local computer. You can then run the installation program to re-install RockWorks. This process will restore all of the menu settings back to factory defaults; use the **Tools** / **Export Menu Settings** option before re-installation to save your own menu settings to a text file which can then be re-imported after the update (**Tools** / **Import Menu Settings**).

Show Help Messages on Startup Check this box to display the RockWorks Help window automatically each time the program is launched. Should you disable this and then wish to access the Help system, simply select the Help / Contents option, the Help / Tutorial option, or the Help button in most options windows.

Warn User If…

No Points Located when Modeling a Stratigraphic Horizon: If checked the program will notify you if there are no points for a particular stratigraphic top or base. Usually this should be left on, but can be turned off if you have a formation defined in the Stratigraphy Types table for which you have not yet entered any data, and don't want to be repeatedly warned about missing data.

Grid is Missing when creating stratigraphic models: If checked the program will notify you if a grid model is missing as it builds your stratigraphy model. As above, this should probably be left on, but can be turned off if you have a formation defined in the Stratigraphy Types table for which you have not yet entered any data, and don't want to be repeatedly warned about missing surface models.

No Points Within Project Area When Creating Grids and Solids: If checked, the program will warn you if there are no data points being sent to the gridding or solid modeling routines, typically if your project dimensions are outside your data, or if you've turned on data filters that are removing everything.

Available Memory Drops Below a User-Defined Level: Check this box to tell the program to display a warning if available memory drops below a specified percent of total memory.

Main Menu Options:

Initial Size: ***Full Screen***: The main RockWorks program window will start up in maximized mode, filling the screen. ***User Defined***. The main program window will start up at whatever size it was last run in.

Display Icons within Tabs: Check this box if you want the tabs along the left side of the program window to include icons.

Display Icons within Top Menu: Check this box if you want the menu items at the top of the screen to include icons.

Display Toolbar: Check this box if you want toolbar buttons displayed along the top edge or left edge of the screen, and expand this heading to select their location.

Secondary Menu Options: Expand this heading to establish settings for the tree-style menus displayed in many of the program Options windows.

Initial Size: ***Large***, which will be slightly smaller than the main menu window) or ***Small***, 738 x 480 pixels).

Show Pull-Down Menu: Check this for display of the File, View, Help menus in the Options windows.

Show Toolbar: Check this to display the toolbar buttons in the Options windows.

Button Size: Choose ***Large***, which will include labels, or ***Small***, which will not.

Background Color for Variables: Choose the colors for menu item variables (such as file names) when they are selected versus not.

Icons: Choose whether icons are to be displayed for selected options items.

Define when Menu Settings are Saved: Here you can choose whether the changes that you make to items in an Options window are saved as soon as you change them (and would be stored even if you cancel the operation) or are saved only if you click the Continue button to proceed with the operation.

Default Image File Type: Choose the default file type and extension to be displayed when you are specifying output files.

Data-Sheets: Expand this heading to adjust the font used in the RockWorks Utilities datasheet. You can also adjust the background color.

Diagram Scaling: Use this option to define how the program will scale the items within graphic diagrams.

Based on XYZ Coordinates: This is the default setting. This tells the program to dimension diagram items (such as log widths, text sizes, etc.) as a percent of the XYZ range of the project. You can see the XYZ extents for the project in the Project Dimensions / Advanced Options / Stats window, in the Diagonal Distance entry. Example: Let's say your project's XYZ extents are 1000 feet. If your log stratigraphy columns are set to a size of "2" (representing percent), then they'll be displayed at an actual diagram width of 20 feet. When displayed in RockPlot2D you could use the Measure / Distance tool to actually measure the item's actual diagram width.

Based on XY Coordinates: This option sets the the diagram items to a percent of the XY range of the project. This can be helpful if your project is really deep and your diagram items are being displayed too large.

User Defined: Choose this item if you want to manually establish a reference size, and expand this heading to enter the size. For example, if you set the size to "500", and your log stratigraphy columns were set to a size of "2", then they'll be displayed at an actual diagram width of 10 feet.

Tables: RockWorks tables are no longer listed in this menu. Instead, click on the large Tables button along the left edge of the main program window to access the table listing.

Program Defaults

The default settings for the program preferences, discussed above, as well as all of the individual menu items, are stored in a file in the program's "system" folder (My Documents\RockWorks14\System\MenuSettings.ini). This menu settings file is created the very first time you start up the program, and it is updated each time you use any of the menus in the program or change any default settings. By saving all of the program defaults on disk, when you exit RockWorks and then start it up again, all of your last settings will be remembered.

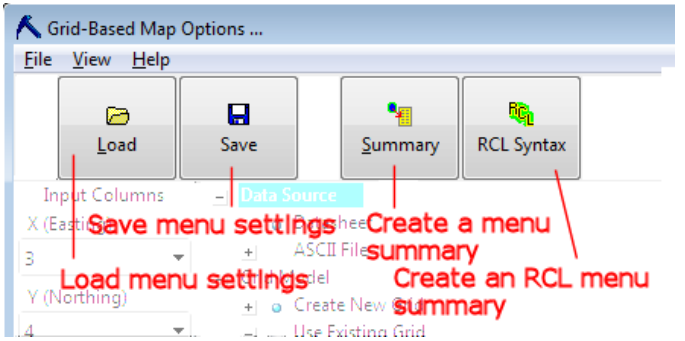
If you re-install RockWorks (see page 3), then this menu settings file would be overwritten with the factory default settings. To prevent your losing all of your

preferences, the installation program will (1) look for the menu settings file and if it exists, (2) offer you the option of saving your existing settings in a backup file. After installation, you then can use the **View / Import Menu Settings** tool to re-load this backup file and re-establish your previous settings.

Should you wish to create a copy of your menu settings, perhaps to set up your laptop copy with the same suite of defaults, you can use the **View / Export Menu Settings** option to save a copy of the file, for later import into the other copy of the program.

Program Menu Settings

At the top of most of the RockWorks program Options windows, you'll see several buttons which can be used to save and load the settings for this program option, as well as to save a report of the settings in two different formats



Saving Menu Settings:

There are two ways to save the currently displayed menus settings from an RCL (RockWorks Command Language) file:

- Select the **File / Save Menu Settings** command from the main menu at the top of the dialog box.
- Press the Save Menu Settings button within the button-bar at the top of the dialog box just below the main menu.

Loading Menu Settings:

There are two ways to load menus settings from an RCL (RockWorks Command Language) file into the currently displayed menu:

- Select the **File / Load Menu Settings** command from the main menu at the top of the dialog box.
- Press the Load Menu Settings button within the button-bar at the top of the dialog box just below the main menu.

These files may be created manually (via a text editor) or by using the Save Menu Settings option (see next item).

View a Summary of the Menu Settings

Menu summaries can be used in the following situations:

- Technical Support: When providing technical support, RockWare employees will frequently ask the end-user a litany of questions about their menu settings. This can become quite exasperating for both parties given that some menus may contain up to 600 settings. This new capability can be used to short-circuit this process by allowing a user to e-mail the menu summary to the RockWare technical support staff.
- Audit Trail: When performing analyses, creating models, or generating diagrams it is often useful to record the menu settings. In the past, this was accomplished by writing down the salient settings on paper. This new feature can be used to quickly record everything and to save the file with a suitable name. For example, if you are creating a stratigraphic fence diagram, you might want to save the menu settings as "Stratigraphic Fence Diagram Menu Settings.txt".
- RCL Developers: The "Show-Variable Names" sub-item will list the variable names adjacent to each menu item. This provides RCL (RockWorks Command Language) developers with a list of variables that they may wish to adjust within their script files.

There are two ways to view a summary of the menu settings:

- Select the **View** / **Menu Summary** command from the main menu at the top of the dialog box.
- Select the Menu Summary button within the button-bar at the top of the dialog box just below the main menu.

A menu summary shows all of the menu settings with the associated RCL parameters in parentheses.

View a Summary of the RCL Settings

There are two ways to view a summary of the RCL (RockWare Command Language) settings that are associated the currently displayed menu:

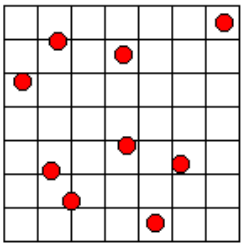
- Select the **View** / **RCL Syntax** command from the main menu at the top of the dialog box.
- Select the RCL Syntax button within the button-bar at the top of the dialog box just below the main menu.

An RCL listing shows the commands that would be used run the same operation in a batch fashion (via the **File** / **Compile RCL**) without using any menus.

Gridding Reference

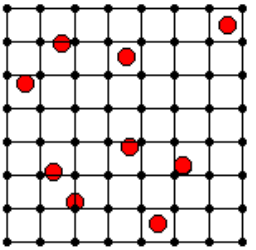
Gridding is a process in which scattered, spatially-distributed data can be transformed into a continuous array or grid of numeric values. Data to be gridded can represent anything from topographic elevations in a county to ratings of local pizza joints, as long as the original data points have location coordinates (X and Y) and a measured "Z" value of some kind. The locations coordinates must be in a Cartesian coordinate system.

You might picture a data grid as a grid of imaginary lines that overlays your source data points.



Your data points, listed in the spreadsheet.

In the process of gridding, the program assigns a value to the grid line intersections, called grid nodes.



Computed grid nodes.

A grid file is the computer file of numbers that contains the results of the gridding process. It contains a listing of the X and Y location coordinates of the regularly-spaced grid nodes and the extrapolated Z value at each node.

Within RockWorks, you can perform "basic" gridding of generic X,Y,Z data for 2D and 3D maps using the RockWorks Utilities Map / Grid-Based Map command. You can also create grid models of stratigraphic surfaces and aquifer surfaces in the Borehole Manager (Stratigraphy and Hydrology menus).

The program offers several methods to do this interpolation of your data. Each operates differently, and each has strengths and differences. See "Gridding Methods" below. Grid files can also result from other RockWorks Grid, Volume, and Solid menu tools.

Gridding Methods

There are several methods offered to interpolate your data.

Closest Point: Each grid node is simply assigned the value of the closest control point.

Cumulative: Nodes represent the sum of the control point values within the node area. Helpful for modeling weighted occurrence data.

Directional Weighting: Uses Inverse-Distance with a directional weighting bias.

Distance to Point: Each grid node is assigned a value that represents its distance, in your X,Y map units, to the closest control point.

Inverse-Distance: A common method using a weighted average approach to compute node values.

Kriging: Its strength is in identifying patterns across the data, including directional trends.

Multiple Linear Regression: Simple distance weighting is applied to a regression analysis.

Sample Density: This algorithm assigns grid node values by simply counting the number of occurrences of control points within the corresponding grid cells.

Trend Surface Polynomial: It finds regional trends in your data.

Trend Surface Residuals: It determines local differences from regional trends.

Triangulation (grid-based): It uses a network of triangles to determine grid node values.

Hybrid: Estimates a surface using two or more different gridding methods, with an option to weight the methods differently.

Help / Contents / Reference / Gridding Reference / Gridding Methods.

General Gridding Options

Polynomial Enhancement: This option works nicely if your data has any regional trend. If activated the program will fit a polynomial surface to your data and compute the residuals for each control point (representing the difference between the source z-value and the polynomial-computed z-value). The program will then grid the residuals using the selected gridding method (Triangulation, Inverse-Distance, etc.). The residuals grid and the polynomial grid are then added together.

If you turn on the polynomial enhancement, you may select Automatic to have the program compute the best-fitting polynomial for your data. Or, you can select the order of the polynomial yourself by clicking in one of the remaining radio buttons.

For a summary of how well each polynomial order fits your data, you can run, separately, a Trend Surface Report (RockWorks Utilities Grid menu, page 165).

Declustering

The Declustering settings in the Surface Modeling Options window tell the program how you want to deal with duplicate or clustered points. Here's how the process works:

Prior to modeling, the program will lay an imaginary "pre-grid" over the data points, at a resolution you declare. If you set the resolution to "250," for example, the pre-grid will be comprised of 250 cells by 250 cells.

For each pre-grid cell, the program locates any data points within it. If a single data point lies within the cell, then the cell is assigned that point's z-value. If more than one point lie within the cell, then the cell is assigned an average of all of the z-values. Any pre-grid cells with no data points are discarded. It is the pre-gridded data that is then sent on to the surface modeling routine.

This method works nicely if you have data sampled along lines or in clusters, such as along seismic lines.

Logarithmic Gridding

The Logarithmic gridding option can be helpful for creating grid models of highly anomalous data. If activated, here's how it works:

The control point z-values are converted to natural logarithms. If a control point has a value less than or equal to zero, the logarithmic z-value will be set to zero.

A grid model, based on the logarithmic data, is interpolated.

The nodes within the grid model are then converted back to the original units by exponentiation.

The control point z-values are converted back to their original units by exponentiation.

Data sets that contain large "outliers" (i.e. values that are far beyond the typical range of data) are typically problematic when the goal is to highlight these anomalous regions. By computing and gridding the natural logarithm of the control point values, the regional effects of these outliers is more localized as shown by the following diagram. The net effect is to highlight anomalous regions (e.g. contaminant plumes).

Note: The new logarithmic capability should be restricted to data sets that contain geochemical or geophysical data with grossly anomalous data points. It is not well suited for surface elevation data due to the fact that these data sets typically include negative z-values (i.e. sub-sea elevations).

High-Fidelity

When selected, this option will "tweak" the final grid model (after the smoothing option has been applied) such that the contours will do a better job of honoring the control points, regardless of the algorithm or the grid smoothing (below). The capability uses a recursive algorithm that grids the residuals, adds them back into the original model, and repeats the process until the cumulative error drops below a threshold. Note that those cells that contain more than one control point are re-defined such that the node value equals the average of all of the control point values within the cell.

Polynomial Enhancement

This tool works nicely if your data has any regional trend. If activated the program will fit a polynomial surface to your data and compute the residuals for each control point (representing the difference between the source z-value and the polynomial-computed z-value). The program will then grid the residuals using the selected gridding method (Triangulation, Inverse-Distance, etc.). The residuals grid and the polynomial grid are then added together.

Smooth Grid

When activated, this tool averages the Z-values in the grid model based on a user declared "filter" size. The smoother can be run 1 or more times, to get rid of spurious "noise" within the grid model and bring out regional trends. (This is also available as a filter within the **Grid** / **Filter** menu.) Expand this heading to establish:

Filter Size: This setting defines how many adjacent nodes should be used when computing the average (smoothed) Z-value for each grid node. If you enter "1", then each node will be assigned the average of itself and the 8 nodes immediately surrounding it, 1 layer deep. If you enter "2", the node will be assigned the average of itself and the 24 nodes immediately surrounding it, 2 layers deep. When in doubt, enter "1".

Iterations: Enter the number of times the entire model should be run through the smoother.

Densify

This feature will automatically add additional points to the xyz input by fitting a Delaunay triangulation network to the data and then adding the midpoint of each triangle to the list of xyz points. The net result is that the subsequent gridding process is now using more control points which tends to constrain algorithms that may become "creative" in areas where there is little control.

Help / Contents / Reference / Gridding Reference / General Gridding Options.

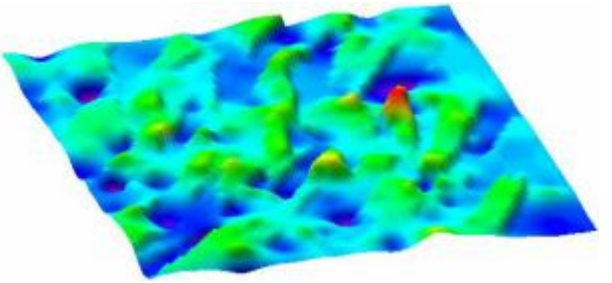
Faulting

RockWorks offers two gridding methods that support faults: Inverse Distance and Multiple Linear Regression.

Faults are defined as "polylines" within ASCII files. Multiple (discontinuous) polylines can be defined for a single project. These polylines can contain many vertices. Note that as the number of polyline segments increase, so does the time required to create the faulted grid model.

A fault polyline file can be created in several ways: by typing coordinate pairs into a text editor (such as Notepad), and using the on-screen digitizer in RockPlot2D.

Faulting can be applied to a single grid surface, or to multiple grids in a stratigraphic model, but note that the faults are assumed to be vertical.



Help / Contents / Reference / Gridding Reference / General Gridding Options.

Grid Model Dimensions

The grid Dimensions options are used to establish the number of nodes to be created in the grid model and the boundary coordinates of the model. These options are available:

Hardwire Project Dimensions: Choose this dimensioning option if the grid dimensions are to be taken from the current Project Dimensions settings (see page 69). This is generally a good idea, particularly in projects where multiple models are going to be created and may need to undergo comparison, mathematical, and filtering operations (in which all models must be dimensioned the same). Expand this heading if you wish to view or reset these settings.

> ***Adjust Project Dimensions***: Click on this item to view and/or reset the project's dimensions. These are the same settings you can access using the large Project Dimensions tab along the left edge of the RockWorks program window.

Variable (Data-Specific) Dimensions: Choose this dimensioning option if the grid dimensions are to be established based on the current data being modeled. This could be an option for modeling a subset of the entire project or for testing the effect of different node densities without having to reset the entire project's dimensions. Expand this heading to select the variable options for Grid Dimensions.

> ***Average Minimum Distance***: Choose this option to set grid dimension defaults based the average minimum distance between control points or boreholes. Expand this item to enter the "scaler" to be multiplied by this distance.
>
> For example, if you choose Average Minimum Distance and enter a scaler of "0.5" the grid node spacing will default to one-half (0.5) the average control point distance, delivering an average of 2 nodes between control points. If you enter a scaler of "0.1" the grid node spacing will default to one-tenth (0.1) the average control point distance, resulting in an average of 10 nodes between control points.
>
> This works well for densely-spaced data. This will create very coarse grid models with sparse data. The boundary defaults will correspond to the outermost control

point locations.

Manual: Choose this option to set grid dimension defaults based on a constant value you enter. For example, if you enter 50, the grid will have 50 nodes from north to south and 50 nodes from east to west. The boundary defaults will correspond to the outermost control point locations.

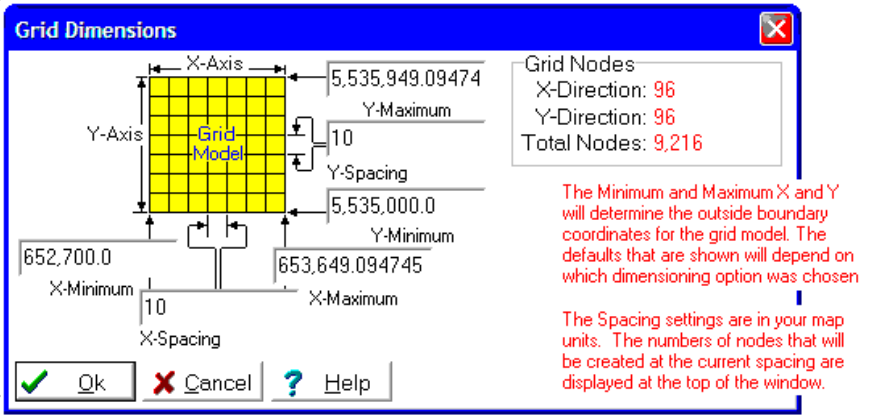
The number of nodes you declare will be modified if the map area is not square. In trying to keep node spacing as close to equal as possible along both axes, the program will reduce the number of nodes created along the area's short axis. If you request dimension confirmation, below, you will have the opportunity to view and confirm the program-recommended node spacing prior to model generation.

The more nodes you specify, the denser the model. The more computations the program needs to do, the longer the time required to create the model. Denser is not always better. You might create less-dense models on trial runs.

Current: Choose this option to have grid dimensions set to the same boundary coordinates and spacing as were used in the last gridding session - the program will not scan the source data to compute new boundaries and spacing. This can be handy if you are creating successive grid models and you want them all to have the exact same boundary coordinates and node spacing.

! This can be dangerous, however, if you switch projects. The program may recommend grid coordinates that have no relation to the current project.

Be sure the ***Confirm Dimensions*** option is checked if you want to view/override the program-computed dimensions before gridding begins.



If this window is displayed, you can adjust any of the coordinate boundary or spacing settings.

RockWorks Grid File Format

RockWorks stores grid and solid model files in an ASCII (text) format. Note that all real number coordinate and Z-values are listed in the files in scientific notation.

A summary of the contents is listed here:

The first line lists the X-coordinate of the westernmost grid node.

The second line lists the Y-coordinate of the southernmost grid node.

The third line lists the number of nodes that are listed for the X-axis (west to east), and the fourth lists the number of nodes listed for the Y-axis (south to north).

The fifth and sixth lines list the spacing, in map units, of the grid nodes along the X-axis and Y-axis, respectively.

Starting in the seventh line, the Z-values for the grid nodes are listed, starting with the grid node in the southwestern corner of the grid and proceeding to the north. When the top of that first column of nodes is reached, the listing proceeds with the second column, starting with the southernmost node and listing upward. A Z-value will be listed for each node in the GRD file.

The grid file format also supports an optional block of data that contains fault segment information. This fault "block" consists of a header, a list of fault segment endpoints, and a terminator. This block is automatically appended to grid models by gridding algorithms that support faulting (e.g. inverse distance). This information is then used by programs that process grid models, including grid smoothing, solid-fill color contouring, line contouring, and fault plotting.

Help / Contents / Reference / File Formats / RockWorks Grid File Format.

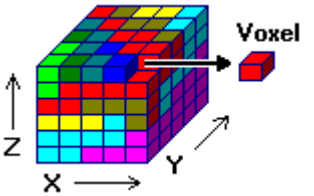
Solid Modeling Reference

Solid modeling is a true 3-dimensional gridding process, in which a solid modeling algorithm is used to extrapolate G values for a fixed X (Easting), Y (Northing), and Z (elevation) coordinates. The G values can represent geochemical concentrations, geophysical measurements, or any other downhole or subsurface quantitative value.

The RockWorks Utilities **Solid** / **Model** tool creates solid models from X, Y, Z, and G data listed in the main datasheet or in an external ASCII file. The Borehole Manager **Lithology**, **I-Data**, **P-Data**, and **Fractures** menu tools (Profile, Section, Fence and Model) create solid models from lithology, interval-sampled, point-sampled, or fracture data in the respective data tabs.

Once it knows the dimensions of your study area, the program divides it into three-dimensional cells or "voxels," their dimensions automatically or user-determined. Each voxel is defined by its corner points or node. Each node is assigned the appropriate X, Y, and Z location coordinates according to its relative placement within the study area. A

fourth variable, "G", which can represent grade of ore, concentration of pollutants, etc., is estimated based on the G value of the given data points.



There are several methods offered to do this interpolation of your data. Each operates differently, and each has strengths and differences. These are discussed under Solid Modeling Methods below.

Help / Contents / Reference / Solid Model Reference.

Solid Modeling Methods

There are several methods offered to perform the 3-dimensional interpolation of your data. Each operates differently, and each has strengths and differences.

Closest Point: The most basic solid modeling method, in which the value of a voxel node is set to be equal to the value of the nearest data point.

Distance to Point: This method assigns each solid model node a value equal to the distance to the closest control point. The distance is recorded in your X,Y,Z units

Inverse Distance: Isotropic, Anisotropic, or Weighted. This method assigns a voxel node value based on the weighted average of neighboring data points, either all points or those directionally located, using fixed or variable weighting exponents.

> *Isotropic*: The program will use all of the available data points when computing a voxel node's value, useful when modeling uniformly distributed data in non-stratiform environments. Weighting exponent = "2". *Anisotropic*: Instead of using all available control points for the Inverse-Distance modeling, the program will look for the closest point in each 90-degree sector around the node, useful for modeling drill-hole based data in stratiform deposits. Weighting exponent = "2". *Weighting*: Uses all data points, but weights them differently based on their horizontal v. vertical positioning from node. Useful for controlling the lenticularity of the model. Weighting exponent = user-declared.

Directional Weighting: This functions like the Inverse Distance method except that you can specify a trend direction and strength, and the program will vary the weighting exponent so that points along the trend influence the node more than closer points perpendicular to the trend.

Horizontal Biasing: This method functions like the Inverse Distance method except that the user can define a vertical distance from each voxel node beyond which points will no longer be used in computing the node value

Horizontal Lithoblending. This method should be used for creating lithology solid models (for Profiles, Fences, and Models) in the Borehole Manager

Help / Contents / Reference / Solid Model Reference / Solid Modeling Methods.

General Solid Modeling Options

Solid Model Declustering

The ***Declustering*** option in the Create New Solid Model settings is a solid modeling model pre-processing option, applicable to all solid modeling methods except for the Horizontal Lithoblending. If activated, Declustering reduces the number of control points sent to the solid modeling algorithm by "snapping" them to the closest node (averaging them with other points close to the node), and then modeling the new, smaller set of averaged points. When modeling densely-sampled downhole geophysical or geochemical data, this can speed up the processing tremendously, with little degradation of data.

Tilted Modeling

This option will bias your data modeling with a user-selected direction and dip. It works like this: (a) The control point elevations are vertically shifted, based on the orientation of the user-defined plane. (b) The solid model is interpolated (based on the vertically shifted coordinates). (c) The corresponding nodes within the model are then shifted back to their proper elevations based on the corresponding elevations within the user-defined plane.

Why? Algorithms such as the horizontal lithoblending strongly bias the interpolation in a horizontal fashion. The "tilt" option introduces a regional gradient while still allowing the modeling to be horizontally biased.

Warp Model Based on Grid

This option will bias your data modeling with a grid model (surface). It works much like the tilted modeling, above, except that instead of a dipping (flat) plane, the model is warped based on a user-selected surface (grid) model . Here's how this works: (a) The control point elevations are vertically shifted, based on the corresponding elevations within the reference grid. (b) The solid model is interpolated (based on the vertically shifted coordinates). (c) The corresponding nodes within the model are then shifted back to their proper elevations based on the corresponding elevations within the reference grid. Why? Algorithms such as the horizontal lithoblending strongly bias the interpolation in a horizontal fashion. The "warp" option introduces structure while still allowing the modeling to be horizontally biased.

! Be sure the grid model and the solid model being created have the same X,Y dimensions and node spacings.

Logarithmic

The Logarithmic modeling option can be helpful for creating solid models of highly anomalous data. If activated, here's how it works: The control point G-values are converted to natural logarithms. If a control point has a value less than or equal to zero,

the logarithmic G-value will be set to zero. A solid model, based on the logarithmic data, is interpolated. The nodes within the model are then converted back to the original units by exponentiation. The control point G-values are converted back to their original units by exponentiation.

Data sets that contain large "outliers" (i.e. values that are far beyond the typical range of data) are typically problematic when the goal is to highlight these anomalous regions. By computing and gridding the natural logarithm of the control point values, the regional effects of these outliers is more localized as shown by the following diagram. The net effect is to highlight anomalous regions (e.g. contaminant plumes).

High-Fidelity

When selected, this option will "tweak" the final solid model (after the smoothing option has been applied) such that the node values will do a better job of honoring the control points, regardless of the algorithm or the smoothing. This is accomplished by modeling the residuals, adding the residuals model to the initial model, and then overwriting the node values with the original control point values. Unlike the grid version of high fidelity, this is not an iterative algorithm (too slow).

Model Constraints: Grid Filtering

The ***Upper Surface Grid Filter*** and ***Lower Surface Grid Filter*** options (previously called “stratabound”) are used to constrain a solid model between a user-specified upper and/or lower surface (grid model). Nodes that lie outside the surfaces will be assigned a constant, user-defined value. This tool requires that the surface model(s) to be used to constrain the model already exist. You can activate either an upper surface, lower surface, or both; browse for each grid model to be used as the filter. Use the ***Undefined Node Value*** setting to enter an integer or decimal value to assign to the solid model voxel nodes that lie outside the stratigraphic unit. Note that you can use this setting to filter a solid model below the ground surface by using the upper filter only.

Smooth Model

When activated, this tool averages the G-values in the solid model based on a user declared "filter" size. The smoother can be run 1 or more times, to get rid of spurious "noise" within the solid model and bring out regional trends. (This is also available as a filter within the Solid / Filter menu.) Expand this heading to establish horizontal and vertical filter sizes, and iterations or number of times to run the smoother.

Maximum Distance Filter

You can activate this option to assign a value automatically to nodes that are more than a user-defined distance from a control point, regardless of the modeling algorithm.

Filtering X, Y, Z and/or G Data

The Filter Points option in the Create New Solid Model settings is used to establish data limits for the X, Y, and Z coordinates (to model a spatial subset), or for the G data to be

modeled. The program will ignore data that lies outside the declared range(s), omitting that data from the solid modeling process.

Help / Contents / Reference / Solid Model Reference / Filtering X, Y, Z and/or G Data for specifics.

Solid Model Resolution

The Model Dimensions options are used to establish the boundary coordinates and the number of nodes to be created in the solid model.

The more nodes you specify, the denser the model. Remember that a 10-node x 10-node x 10-node model (very low resolution) will contain 1,000 nodes; a 50-node x 50-node x 50-node model will contain 125,000 nodes; and a 100 x 100 x 100 model will contain 1 million nodes. The more computations the program needs to do, the longer the time required to create the model. Denser is not always better. You might create less-dense models on trial runs.

These settings are offered:

Hardwire Project Dimensions: Choose this dimensioning option if the solid model dimensions are to be taken from the current Project Dimensions settings (see page 69). This is generally a good idea, particularly in projects where multiple models are going to be created and may need to undergo comparison, mathematical, and filtering operations (in which all models must be dimensioned the same). Expand this heading if you wish to view or reset these settings.

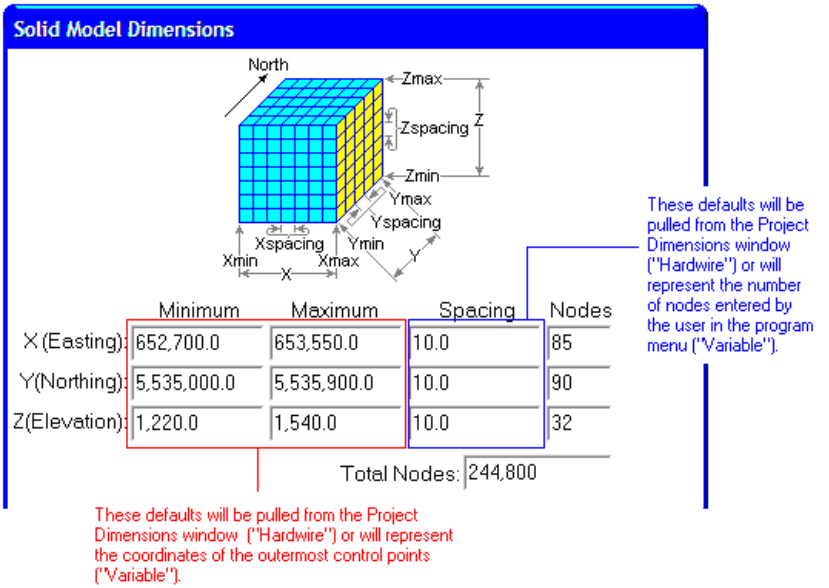
> ***Adjust Project Dimensions***: Click on this item to view and/or reset the project's dimensions. These are the same settings you can access using the large Project Dimensions tab along the left edge of the RockWorks program window. Click here for more information.

Variable (Data-Specific) Dimensions: Choose this dimensioning option if the solid model dimensions are to be established based on the current data being modeled. This could be an option for modeling a subset of the entire project or for testing the effect of different node densities without having to reset the entire project's dimensions. Expand this heading to select the variable options for Solid Dimensions.

> ***Horizontal***: Type here the number of nodes to be created from west to east and from north to south. The boundary defaults will correspond to the outermost control point locations.
>
> The number of nodes you declare will be modified if the map area is not square. In trying to keep node spacing as close to equal as possible along both axes, the program will reduce the number of nodes created along the area's short axis. If you request dimension confirmation, below, you will have the opportunity to view and confirm the program-recommended node spacing prior to model generation.
>
> ***Vertical***: Type here the number of nodes to be created vertically in the model. This axis can be set to a different density that the X and Y (Horizontal) axes, above. The

boundary defaults will correspond to the lowest and highest control point elevations. If you request dimension confirmation, below, you will have the opportunity to view and confirm the program-recommended node spacing prior to model generation.

Insert a check in the ***Confirm Dimensions*** box to request display of program-computed model dimensions and node spacing prior to modeling. At that time you can view and override the defaults.

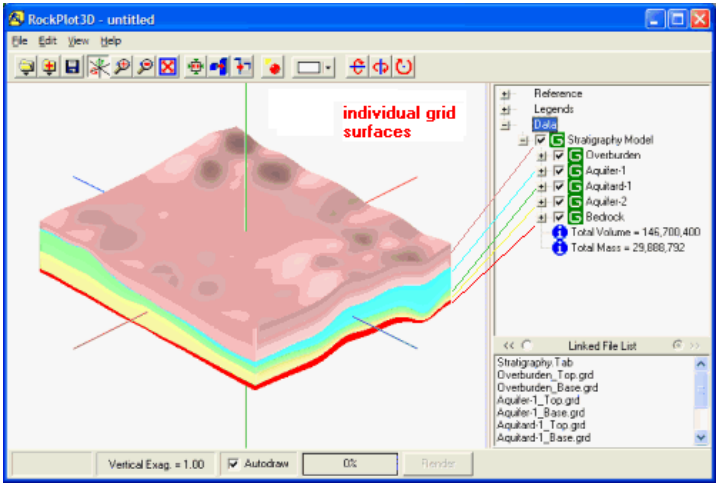


If this window is displayed, you can adjust any of the coordinate boundary or spacing settings.

Help / Contents / Reference / Solid Model Reference / Solid Model Resolution.

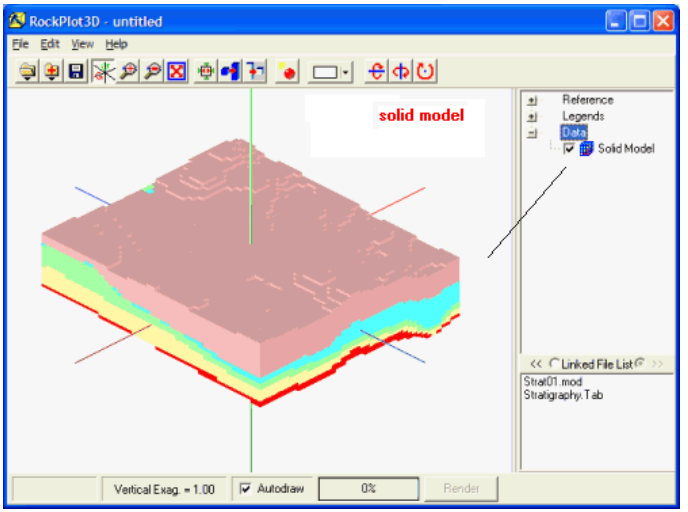
Stratigraphy Model versus Stratigraphy Solids

When you use the Borehole Manager's **Stratigraphy** / **Model** tool to create a 3D display of all of your stratigraphic units, what RockWorks creates is a series of grid surfaces with sides for display in RockPlot3D. The benefits to this type of display and modeling are the nice looking surfaces, the ability to turn individual surfaces on and off in RockPlot3D, the ability to edit individual surfaces, and more.



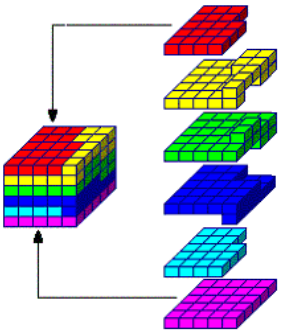
Stratigraphy Model: Stacked Grid Surfaces

RockWorks also offers the option of building a stratigraphic solid model of the stacked surfaces. This is done with the Save Model checkbox in the Stratigraphy / Model tool. These stratigraphic solids are true solid models that represent the 2-dimensional grids stacked on each other, depositionally, from the bottom up. Stratigraphic solids have three fixed dimensions: X (Easting), Y (Northing), and Z (elevation), with a variable G-value which represents stratigraphy type as an integer. These formation "G" values are declared in the Stratigraphy Types Table.



Stratigraphy Solid

Like geochemical or geophysical solid models, stratigraphic solid models are just files that contain listings of X, Y, Z, and G numbers. Unlike solid models which contain real number G values, stratigraphic models usually contain integer G values that correspond to the formations. You might picture a stratigraphic solid as a stack of cubes. In the cartoon below, the 3-dimensional cells, or voxels, are color-coded based on their G-value or stratigraphy type. The model is constructed by “inserting” the 2-dimensional grid models of each stratigraphic layer (top AND base), from the bottom up.



The stratigraphic solid can be displayed in RockPlot3D using the RockWorks Utilities Solid / Model tool, selecting Use Existing Model and identifying the .MOD file name. You should choose All Voxels as the diagram type. When displayed in RockPlot3D, you can double-click on the Solid Model item to set the Color Scheme to the Stratigraphy Types Table from which the model was created. Stratigraphy solids have the same file structure as regular geochemistry / geophysical / fracture solid models.

With the introduction of RockPlot3D for visualizing multiple grid models as surfaces in 3D, users may not use stratigraphic solids as much as they did in RockWorks99.

Help / Contents / Reference / Solid Model Reference / Stratigraphy Models versus Stratigraphy Solids.

2-Dimensional Map Layers

RockWorks offers the following "layers" for two dimensional maps. A layer is activated if a check-mark is displayed in its check box. To access the layer's settings, expand its sub-topics by clicking on its "+" button.

Bitmaps: Displays an image in the background of the other map layers. BMP, JPG, TIFF, WMF, EMF, and PNG images are supported.

Symbols: Illustrates the sample sites in the main data sheet with map symbols.

Labels: Plots labels for the sample sites, usually used with the symbols layer.

Contours: Plots lines representing the distribution of "z-values" (elevation, geochemistry, etc.) in the study site.

Color-filled intervals: Plots solid color-filled regions representing the distribution of z-values in the study site.

Labeled-Cells: (Available only for grid-based maps.) Draws a grid of lines corresponding to the grid model nodes, and fills the cells with labels for the node values.

Borders: Plots border tick marks and coordinates labels, and axis titles.

Triangulation Network: (Available only for EZ maps, if contours or color filled intervals are selected.) Displays the network of triangles constructed by the program to build the map contours.

Help / Contents / Reference / 2D Map Options.

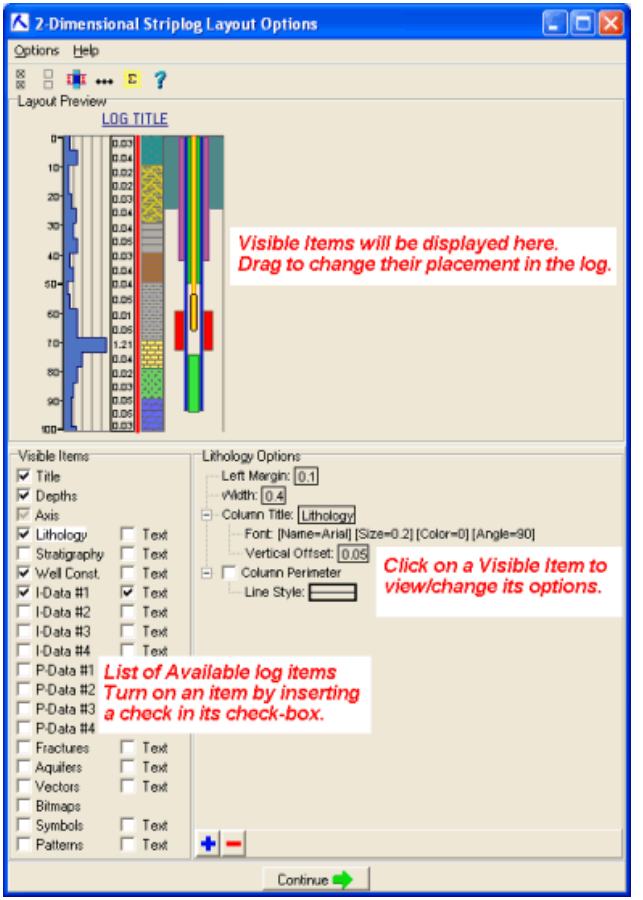
2D Striplog Options

The Borehole Manager Striplogs menu offers tools for creating a 2D display of a single log and of multiple logs in a profile and cross section. 2D logs are also available in the Lithology, Stratigraphy, I-Data, P-Data, Fractures, and Aquifers menus to append to those menus' panel-based profiles and sections.

When you select:

- Striplogs / Single Log 2D menu option
- Striplogs / Profile and Striplog / Section: Adjust Striplog Settings option
- Lithology, Stratigraphy, I-Data, P-Data, Aquifers, Fractures: Plot Logs / Adjust Striplog Settings option

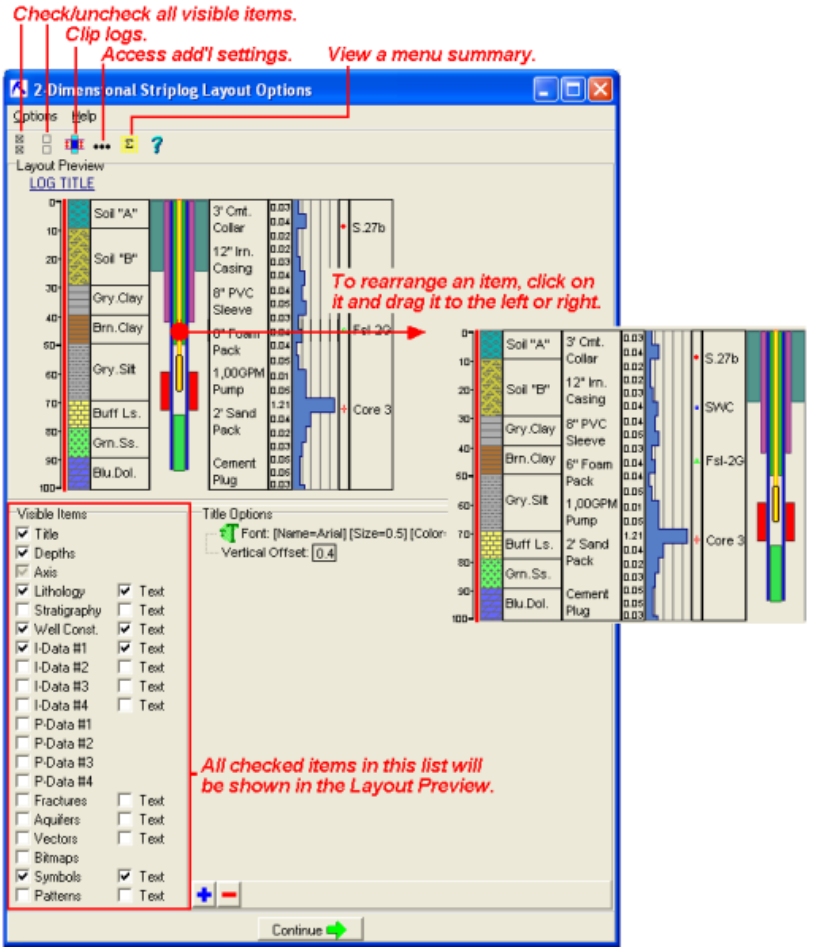
you'll see a window where you can establish which data items will be displayed in the logs, their relative placement in the log, and their appearance settings.



To activate an item, insert a check in its check-box. It will be displayed in the upper preview pane, where you can drag it to the left or right to adjust its placement in the log.

To view/adjust an item's settings, click on its name in the Visible Items column, and modify the settings as necessary in the Options pane, to the right.

Using the Log Designer



Visible Items Summary

Check All: This button and Options menu item will turn on all possible 2D log items.

Uncheck All: This button and Options menu item will turn off all possible 2D log items.

Clip Logs: This button and Options menu item allows you to enter an elevation range, for display of a subset of the log data.

More Options: ••• This button and Options menu item contains settings that control downhole resolution and viewing direction for deviated boreholes.

Visible Items		Description, options
Title		Plots the borehole's name at the top of each log. The title is always plotted above the log axis. Options include font and offset.
	Offset	Determines how far above the log the title will be plotted. The default is Automatic. If you expect to apply vertical exaggeration of 5x or more to your log or section, you might consider setting it to Manual, with a value of 0.
Depths		Plots depth labels down the logs. Settings include labeling interval, font style, etc.
Axis		The axis is always on. It serves as the center point for the log, above which the main log title will plot (if activated). In cross sections, the location of the axis will represent the actual well location. Options: line style, thickness, and color
Lithology		Plots a column in each log containing intervals of pattern and color that correspond to observed lithology material types. The pattern - rock type association is made in the Lithology Types Table. Options include column width & perimeter.
Lithology	**Text**	Plots the lithology keywords, depths and/or thickness.
Stratigraphy		Plots a column in each log containing intervals of pattern and color that correspond to formation names listed in the Stratigraphy data table. The pattern <-> stratigraphy name association is made in the Stratigraphy Types Table. Options include column width.
Stratigraphy	**Text**	Plots the formation names, depths, and/or thickness.
Well Construction		Plots a column in each log displaying intervals of pattern and color that correspond to well construction material names in the Well Construction data table. The pattern + material name association is made in the Well Construction Types Table. Options include column width.
Well Construction	**Text**	Plots the construction material captions, depths, and/or thickness.

I-Data #1, **I-Data #2**, **I-Data #3**, **I-Data #4**		Plots a bargraph representing data read from the Interval (I-Data) table. Options include the data source, scaling, colors, etc.
I-Data	**Text**	Plots the selected I-Data measurements as text labels within a column.
P-Data #1, **P-Data #2**, **P-Data #3**, **P-Data #4**		Plots a point to point curve, with or without fill, representing data read from the Points (P-Data) table. Options include the data source, colors, curve style, logarithmic scaling, etc.
Fractures		Reads measurements from the Fracture table data and plots a tadpole column representing the fracture orientation and dip. Options include colors, title, etc.
Fractures	**Text**	Plots the fracture measurements as text labels within a column.
Aquifers		Plots one or more interval blocks (representing depth to surface and base declared in the Water levels tab) in each log. Options include block width and color, and whether date captions should be plotted.
Aquifers	**Text**	Plots the Water Level measurements as text labels within a column.
Vectors		Reads Vector table data and plots a tadpole column representing the vector orientation and dip. Options include colors, title, etc.
Vectors	**Text**	Plots the vector measurements as text labels within a column.
Bitmaps		Plots downhole raster images in vertical 2D logs. Options include imbedding versus linking the image, and including a border.
Symbols		Plots user-selected symbols at specific depths in each log, as read from the Symbols table. These are commonly used to display water level symbols. There are a variety of special-symbol options.
Symbols	**Text**	Plots the symbol captions as text labels within a column.
Patterns		Plots user-selected pattern blocks between specific depths in each log, as read from the Patterns table. These are commonly used to show screened intervals, and they have a variety of options.

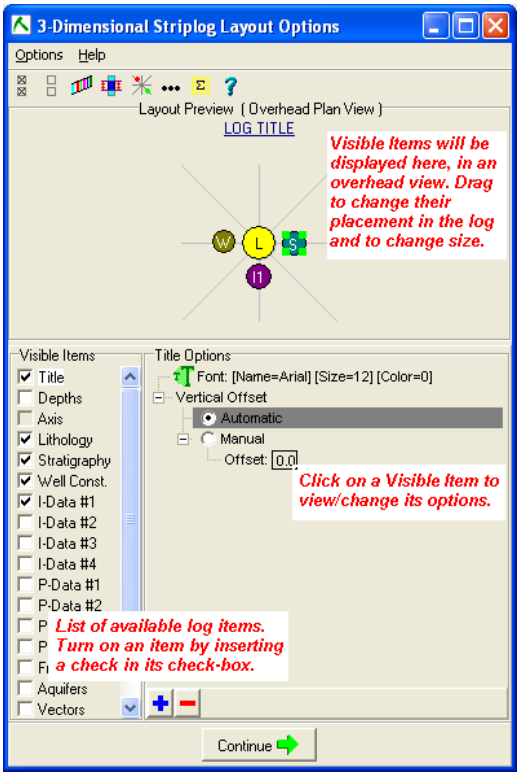
Patterns	**Text**	Plots the pattern captions as text labels within a column.

Help / Contents / Reference / 2D Log Options.

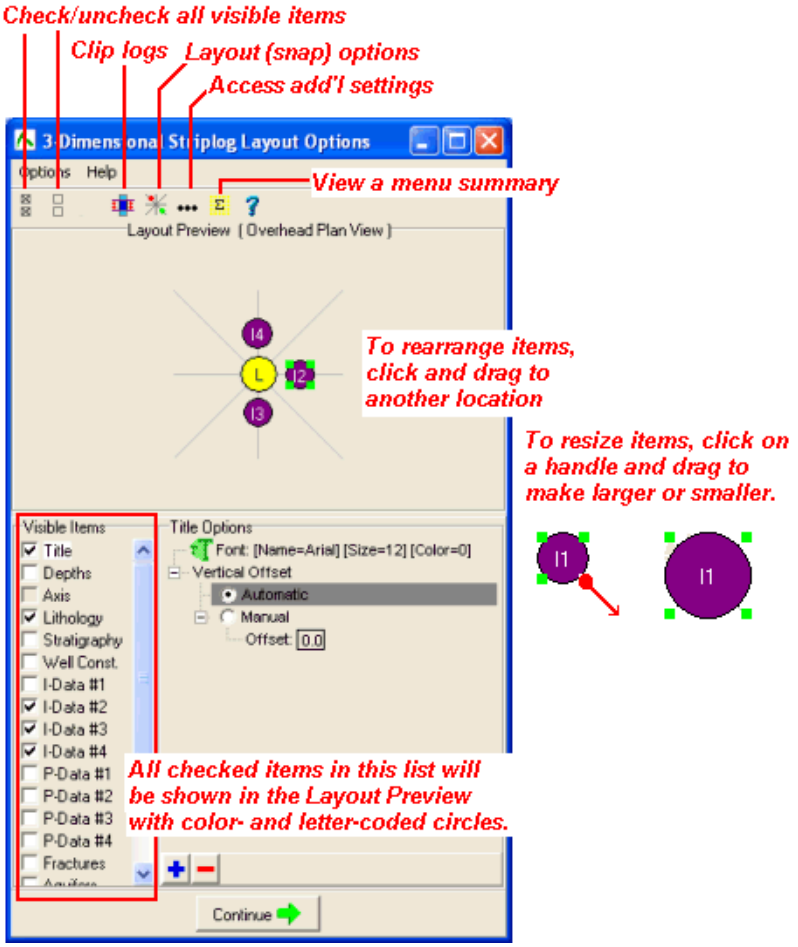
3D Striplog Options

The Borehole Manager Striplogs menu offers tools for creating a 3D display of a single log and of multiple logs. 3D logs are also available in the Lithology, Stratigraphy, I-Data, P-Data, Fractures, and Aquifers menus to append to those menus' 3D models and fence diagrams.

When you select the Striplogs / Single Log (3D) and Striplog / Multi-Log 3D menu options, or the Adjust Striplog Settings option in any other 3D menu item, you'll see a window where you can establish which data items will be displayed in the 3D logs, their relative placement in the log, and their appearance settings.



Using the 3D Log Designer



Visible Items Summary

Check All: This button and Options menu item will turn on all possible 3D log items.

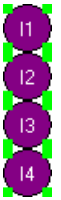
Uncheck All: This button and Options menu item will turn off all possible 3D log items.

Clip Logs: This button and Options menu item allows you to enter an elevation range, for display of a subset of the log data.

Layout Options: This button and Options menu item allows you to turn on snapping and alignment options.

More Options: This button and Options menu item contains settings that control downhole resolution and viewing direction for deviated boreholes.

Visible Items		Description, options
Title		Plots the borehole's name at the top of each log. The title is always plotted above the log axis. Options include font and offset.
	Offset	Determines how far above the log the title will be plotted. The default is Automatic. If you expect to apply vertical exaggeration of 5x or more to your log or section, you might consider setting it to Manual, with a value of 0
Depths		Plots depth labels down the logs. Settings include labeling interval, font style, etc.
Axis		The axis is always on. It serves as the center point for the log, above which the main log title will plot (if activated). The location of the axis will represent the actual well location.
	Style	Choose from a polyline or a 3D tube for the axis, and set the color and thickness (as a percent of the project size).
Lithology		Plots a column in each log containing intervals of color that correspond to observed lithology material types. The color + rock type association is made in the Lithology Types Table. Options include column title and text. (Note that lithology patterns are not plotted in 3D logs, only the ***background color*** defined for the rock type.)
Stratigraphy		Plots a column in each log containing intervals of color that correspond to formation depths. The color + stratigraphy name association is made in the Stratigraphy Types Table. Options include column width. (Note that stratigraphy patterns are not plotted in 3D logs, only the ***background color*** defined for the formation.)
Well Construction		Plots a column in each log containing intervals of color that correspond to well construction material types. The color + material type association is made in the Well Construction Types Table. Options include column title and text. (Note that patterns are not plotted in 3D logs, only the ***background color*** defined for

		the material type.)
I-Data #1, **I-Data #2**, **I-Data #3**, **I-Data #4**		Plots a 3D bargraph representing data read from the Interval (I-Data) table. Options include the data source, scaling, colors, style, etc.
P-Data #1, **P-Data #2**, **P-Data #3**, **P-Data #4**		Plots a point to point curve or 3D discs in a 3D log, representing data read from the Points (P-Data) table. Options include the data source, colors, curve style, etc.
Fractures		Reads measurements from the Fracture table data and plots oriented discs representing the fracture orientation and dip.
Aquifers		Plots one or more interval blocks (representing depth to surface and base declared in the Water levels tab) in each log. Options include column width and color, and whether date captions should be plotted.
Vectors		Reads Vector table data and plots oriented arrow in your 3D logs, representing the orientation and dip. Options include colors, title, etc.
Bitmaps		Plots downhole raster images in vertical 3D logs. Options include imbedding versus linking the image, and including a border.
Symbols		Plots user-selected symbols at specific depths in each log, as read from the Symbols table. These are commonly used to display water level symbols. There are a variety of special-symbol options.
Patterns		Plots user-selected pattern blocks between specific depths in each log, as read from the Patterns table. These are commonly used to show screened intervals, and they have a variety of options.

Help / Contents / Reference / 3D Log Options.

2D Profile and Section Options

Perimeter Annotation: In RockWorks, the 2D cross section diagrams offer some automatic annotation options for the diagram perimeter. These perimeter options are available for both profiles and hole to hole cross sections that display strip logs as well as those with panels representing lithology, stratigraphy, i-data, p-data, aquifers, or fractures. In other words, you'll see these options in many RockWorks program menus.

Border: This option is used to include border annotation labels included in the plot. These labels note elevations and X,Y coordinates or distances. These borders apply to hole to hole and projected sections (Striplogs menu) and all lithology, i-data, p-data, stratigraphic and other profiles.

Create Separate Location Map: the 2D profile and cross section diagrams and the 3D fence diagrams offer an option to create a Location Map that shows the section or panel locations in a plan-view map. Options include traverse line type, endpoint labels, borehole symbols & labels, and map perimeter.

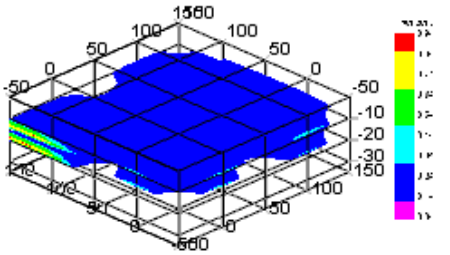
Profile and Section Color Scheme Settings: The Color Options that are available for all of RockWorks solid model Profile and Section tools are used to define how you want the solid model G value represented.

Lithology Legend Settings: These control the appearance of the legend to the rock types and colors/patterns as listed in the project's Lithology Types Table.

Stratigraphy Legend Settings: This controls the appearance of the legend to the stratigraphic formations included in the diagram, which displays names and colors/patterns as listed in the project's Stratigraphy Types Table. Well Construction Legend Settings: These control the appearance of the legend to the materials and colors/patterns as listed in the project's Well Construction Types Table.

See Help / Contents / Reference / Profile and Section Options.

3-Dimensional Image Settings



3D Surface Map Layers

RockWorks offers the following "layers" for three-dimensional surface maps. A layer is activated if a check-mark is displayed in its check box. To access the layer's settings, expand its sub-topics by clicking on its "+" button.

Flat Surface: Displays grid models in 3D as a flat surface.

Boolean Colors: Sets the color scheme specific to Boolean or “true/false” models.

Perimeter: Includes a solid line perimeter around the flat or 3D grid surface.

3D Legends

Lithology Legend: Displays lithology keywords and colors, taken directly from the project’s Lithology Types Table.

Stratigraphy Legend: Displays formation names and colors, taken directly from the project’s Stratigraphy Types Table.

Well Construction Legend: Displays construction material names and colors, taken directly from the project’s Well Construction Types Table.

I-Data or P-Data Legend: Displays G values contained in the geochemistry, geotechnical, or geophysical solid model and the colors used to represent them.

Each of these items can be turned on/off and modified once the diagram is displayed in the RockPlot3D window.

Plotting a “Reference Cage”

Use the Reference Cage item to include in the 3D diagram a "reference cage" noting X, Y, and elevation coordinates. Note that many of the cage items can also be adjusted when displayed in the RockPlot3D window.

Plot Panels: Fills the activated panels with solid color. Note that you can turn the solid panels on and off in the RockPlot3D display. You can also adjust the panel transparency there.

Plot Lines: Displays reference lines within the panels.

Plot Labels: Includes labels along the reference cage boundaries.

North, ***South***, ***West***, ***East***, ***Base***, ***Top***: Plots the respective set of cage items (panels, lines, labels). Note that these can also be turned on and off within RockPlot3D.

Dimensions: Establishes whether the reference cage dimensions are to be determined automatically by the program, or entered manually by the user.

Project Dimensions: Choose this if the reference items are to be plotted at the boundaries currently defined in the Project Dimensions window (page 69).

Adjust Project Dimensions: Click on this item to view and/or reset the project's dimensions. These are the same settings you can access using the large Project Dimensions tab along the left edge of the RockWorks program window.

Automatic: Choose this option to have the program set automatically the reference

cage dimensions, based on the extents of the 3D diagram.

Manual: Choose this option to enter the dimensions by hand.

X-Axis: Set the minimum and maximum coordinate along the X axis for the reference cage, and the spacing (in these same units) for the grid lines.

Y-Axis: set the minimum and maximum coordinate along the Y axis for the reference cage, and the spacing (in these same units) for the grid lines.

Z-Axis: Set the minimum and maximum elevation coordinate for the reference cage, and the spacing (in these same units) for the grid lines.Reference Cage: Labels X, Y, and elevation coordinates, with optional reference lines.

Help / Contents / Reference / 3D Image Options.

Running RockWorks from a Script

Almost all of the applications within RockWorks can be accessed, without displaying RockWorks menus, by placing special commands within an ASCII text file. This functionality is targeted toward users who wish to automate repetitive tasks, and developers who wish to run RockWorks in the background.

The “RCL” or “RockWare Command Language” scripts can be run by selecting the File / CompileRCL option, or via a command line parameter.

Use this tool to read a listing of program commands from a user-created “RCL” (RockWare Command Language) file and to perform the listed operations. This is a means of running RockWorks in “batch” mode to simplify repetitive tasks. The RCL file can also be launched via a command line, eliminating the need to view the menus at all. See the Help messages for more complete information.

Troubleshooting

Please refer to the RockWorks Help / Contents / Reference / Troubleshooting topic for possible answers to program error messages.

Please also visit our support forum: www.rockware.com/forum/index.php for a searchable list of user discussions and questions.

email: tech@rockware.com

tel: 303-278-3534

Summary of RockWorks Menu Options

Borehole Manager Menu Options

File menu	Contains options for opening /creating / managing project databases.
New Project	Each project you work on in the Borehole Manager must have its own folder, called a Project Folder, on your computer. The Project Folder is where the borehole database (.MDB) of the same name is created, for storage of borehole data. Graphic files, grid and solid models, and other accessory files for that project should also be saved in the Project Folder. This option is used to browse to a different folder on your computer or network.
Open Project	Allows you to browse to a different Project Folder and load that project's database. If the database does not yet exist, the new-project wizard will be launched.
New Log	This option is used to start a new borehole record in the current borehole database.
Erase Log	This option is used to delete the current borehole record from the Borehole Manager database.
Erase All Disabled Logs	Deletes all currently-unchecked borehole records from the database.
Duplicate Log	Creates a copy of the currently-selected borehole record.
Import	The Import programs are used to import data from other applications or commercial sources into the Borehole Manager.
ASCII	Imports data from ASCII files into the Borehole Manager database.
gINT	Imports data from gINT log files into the Borehole Manager database.
GDSII (dat)	Imports Geological Data Services (GDS) format files into the Borehole Manager. There are two supported file formats; GDSII, a set of 80 character records for each well, and Township & Range Flat file, one comma separated record for each well.
IHS (PI/Dwight)	Imports well data provided by IHS into the Borehole Manager.
Kansas Geol Survey	This program imports Kansas Geological Survey tops data. It uses the same framework that is employed by the IHS, GDS, and Tobin imports

LAS	This program reads LAS (Log ASCII Standard) files, version 1.2 - 2 for import into the Location and P-Data tables of an existing borehole or a new well record.
Multiple LAS	Imports multiple LAS (Log ASCII Standard) files, version 1.2 - 2 for import into the Location and P-Data tables of existing boreholes or new well records.
LogPlot	Imports one or more LogPlot ".dat" files into the Borehole Manager database.
Newmont Assay mdb	Imports data from a Newmont Assay Mdb file into the Borehole Manager database
Penetrometer	Imports data from Spectrum Penetrometer files into the Borehole Manager database. This data may then be modeled in three-dimensions via the P-Data / Model program in order to gain an understanding of soil compaction.
RockWorks/99	Imports data from RockWorks/99 ATD and linked files into the Borehole Manager database.
RockWorks2002/2004 BH Files	This option is used to import BH files from RockWorks2002 or 2004 projects into the current RockWorks Borehole Manager database.
Tobin WCS	Imports data from a Tobin Well Coordinate Service (WCS) file into the Borehole Manager database.
XLS	Use this tool to bring data into the Borehole Manager from multiple worksheets in an external Microsoft Excel file.
Export	This sub-menu contains tools for exporting records from the Borehole Manager database to another format for editing or use in other applications.
ASCII	Exports the borehole data for a single well or for all enabled wells to a single or to multiple ASCII (text) files.
Dat (LogPlot)	This tool will export the data tables for one, all, or enabled boreholes to an ASCII DAT file that can be used in the RockWare LogPlot program.
XLS	Exports the data tabs for current/enables/all boreholes to Microsoft Excel, each RockWorks data tab a separate worksheet within the output Excel workbook. This program requires that the Excel program is installed onto your computer.
RockWorks2004 BH	Exports the data tables for all boreholes to individual ASCII ".BH" files, compatible with the RockWorks2004 program.
Transfer	The Transfer options are used to transfer data between the Borehole Manager and the RockWorks Utilities datasheet.

Locations -> Utilities Datagrid This program is used to transfer borehole location information from the Borehole Manager database into the RockWorks Utilities datasheet for editing, coordinate translation, mapping, etc.

Stratigraphy -> Utilities Datagrid This program transfers stratigraphic contact elevation data from the Borehole Manager database into the RockWorks Utilities datasheet for editing, mapping, etc.

Borehole Table -> Utilities Datagrid This program is used to export all of the data from the currently active Borehole Manager data tab (e.g. Lithology) into the RockWorks Utilities datasheet.

Backup Database Use this tool to make a backup copy of the current .MDB file. We generally recommend that you do this from time to time, particularly before importing data, deleting data, or filtering data, should you inadvertently make changes you don't wish to keep.

Restore Database Use this option to restore a backup copy (above) as current.

Check Database Integrity Use this option to compare the contents of your current project database against the general program data dictionaries, to see a report of the items that are not in synch and to fix all those that it can. This can be helpful in the event that fields have been added to one of your projects and you re-open another project and the older database no longer matches the modified data dictionaries.

Check Data Integrity Use this option to perform a two-step data check: It performs a database check against the data tables, as described by the topic above, and it also reads through the well data itself to check for mis-placed TD's, stratigraphic units out of order.

Refresh Database Use this option to close and re-open the current project database, without having to close and restart the entire program.

RockPlot2D Use this menu option to open a new RockPlot2D window. RockPlot2D is the 2-dimensional (flat) diagram viewing portion of RockWorks.

RockPlot3D Use this menu option to open a new RockPlot3D window. RockPlot3D is the interactive, 3-dimensional diagram viewing tool in RockWorks.

ReportWorks Use this menu option to open a new ReportWorks window. This is a new program for page layout of RockPlot2D images, raster graphics, with text and shape annotation, legends, and more.

Compile RCL File	Use this menu option to read special "batch" commands listed in a RockWare Command Language (RCL) file and process them within RockWorks.
Close	Select the File / Close command to terminate the RockWorks program.
Edit menu	Offers general data-editing options
Project Dimensions	Brings up the dimensions for the current project folder for viewing/editing.
Enable All Boreholes	This option will place a checkmark next to all boreholes within the borehole list thereby including all of the boreholes in any subsequent computations or diagrams.
Disable All Boreholes	This option will remove all checkmarks within the borehole list thereby excluding all of the boreholes from any subsequent computations or diagrams.
Adjust Total Depths	Use this option to scan all of the data for each borehole in the current project database, and adjust the Total Depth (Location tab) for the borehole should it be shallower than deeper data values.
Calculate XYZ Values	Use this option to update the background XYZ computations for all boreholes in the current project database. They can become out of date if you modify borehole locations, elevations, or downhole surveys. Be warned that this can take some time if you have many boreholes and/or lots of downhole data.
Calculate XYZ Values for Current Borehole	Use this option to update the background XYZ computations for the currently-selected borehole in the project database. They can become out of date if you modify the borehole's location, elevation, or downhole survey.
Edit Data as Spreadsheet	Use this option to load the current data table (such as P-Data or I-Data) for the current borehole into a spreadsheet-style data editor, where you can perform some block editing operations (copy/paste).
View menu	Use this menu to query data, view summaries and XYZ computations, and more.
Filter Boreholes	Use this tool to query all boreholes in the current project database using one or more filters - such as a rectangular map area, specific stratigraphic formations, or specific Location table fields - and disable those boreholes that don't meet all of the criteria. This is a basic "AND" type of filter: each of the

	boreholes for which every criterion is true will be enabled and the remaining boreholes will be disabled.
Select Boreholes	Use this tool to query a subset of boreholes in the current project using one or more filters, and either enable or disable those boreholes. This is similar to the Filter option, except that the Select tool allows successive filters to be applied, and the enabling/disabling will apply only to the boreholes meeting the filter parameters, and no others. So, while the Filter Boreholes tool works as an AND filter, the Select Boreholes tool can function as an AND or OR filter. .
Borehole Summary	Scans the data for the currently-selected borehole and displays a summary.
Show XYZ Values	Use this option to activate the display of the downhole XYZ coordinates for all entered data points in the Borehole Manager window. The program computes these XYZ coordinates in the background and stores them in the project database; this option simply displays them.
Locate Closest Borehole	Use this option to display the borehole data record whose X and Y coordinates are closest to the typed-in coordinates.
Project Information	Use this option to enter miscellaneous information (e.g. “metadata”) about the project, which will be stored in the project database.
Tab Manager	This option is used to choose which of the borehole data tables to be displayed in the Borehole Manager, the order in which they are displayed, and to modify/add fields to the tables.
Optional Fields	Use this option to edit the optional location fields that will be displayed in the Borehole Manager Location tabs and saved in the current RockWorks project database.
RockWorks Utilities	Use this tool to access the RockWorks Utilities window in RockWorks. This has the same effect as clicking on the Utilities tab along the left edge of the program window.
Tables	Use this tool to access the Tables window in RockWorks. This has the same effect as clicking on the Tables tab along the left edge of the program window.
My RockWorks	Use this tool to access the My RockWorks window in RockWorks. This has the same effect as clicking on the My RockWorks tab along the left edge of the program window.

Map menu	The Borehole Manager's Map menu contains tools for generating a borehole location maps, surface elevation maps, and performing coordinate conversions.
Borehole Locations	This program is used to generate borehole locations maps and/or surface elevation contours.
Adjust Coordinates	This option includes programs for converting the borehole location coordinates from longitude/latitude or Range/Township/Section to Eastings and Northings.
Jeffersonian -> Easting/Northing	This option converts Jeffersonian-style range/township/section location descriptions to Cartesian X,Y coordinates (i.e. UTM eastings/northings).
Longitude/Latitude -> Easting/Northing	This program converts longitude/latitude decimal degree coordinates to Cartesian X,Y coordinates (i.e. UTM eastings/northings).
Striplogs menu	This menu contains a variety of tools for creating 2-dimensional (flat) or 3-dimensional logs of individual or multiple borings, and log maps.
Single Log (2D)	Creates a vertical, 2D (flat) strip log of a single well. The log can include any combination of the available log items. The boring can be vertical, inclined, or deviated.
Single Log (3D)	Creates a 3D view of the strip log of a single well. The log can include any combination of the available log items. The boring can be vertical, inclined, or deviated.
Multi-Log Profile	Creates a 2D vertical display of strip logs of multiple boreholes, projected onto a single profile "cut." The logs can include any combination of the available log items. The borings can be vertical, inclined, or deviated.
Multi-Log Section	Creates a 2D vertical display of strip logs of multiple boreholes. The logs can include any combination of the available log items, whose data is read from the data tabs. Hole to hole log sections also offer the ability to hang the section from a selected stratigraphic unit.
Multi-Log Plan View	Creates a 2D plan view of deviated/inclined wells, as projected onto a horizontal plane.
Multi-Log Map	Creates a 2D map with miniature logs plotted next to each map symbol.
Multi-Log 3-D	Creates a 3D view of the strip logs of two or more wells. The logs can include any combination of the available log items. The boreholes can be vertical, inclined, or deviated.

Lithology menu	Use the tools in the Borehole Manager's Lithology menu to interpolate your downhole lithology data into a solid model, and to display the interpolated data in a variety of ways. The lithologies will be color-coded based on their colors in the Lithology Types Table. Volume and export tools are also available.
Model	Creates a lithology model (or reads an existing model), created using a specific lithology modeling algorithm., and displayed as a 3D voxel diagram.
Profile	Interpolates a lithology model (or reads an existing model) and creates a 2D (flat) vertical profile slice of the model, between any two points in the study area. Striplogs can be projected onto the profile.
Section	Interpolates a lithology model (or reads an existing model) and creates a 2D (flat) vertical profile of this model, with multiple panels. The section can be drawn along any path through the study area; it is not necessary to align the panels to borehole locations. Strip logs can be appended.
Fence	Interpolates a lithology model (or reads an existing model) and creates a 3D fence diagram that illustrates the model. You may request regular panel spacing, in a variety of configurations, or you can draw your own panels. 3D logs can be appended.
Surface Map	Interpolates a lithology model (or reads an existing model) and creates a 2D map representing the lithology where it intersects a designated surface, typically the surface topography. In other words, it creates a geological lithology map based on downhole data.
Plan Map	Interpolates a lithology model (or reads an existing model) and creates a 2D map representing the lithology at a designated elevation - representing a horizontal slice through a lithology model.
Volumetrics	Reads an existing lithologic solid model and computes volume of each rock or soil type. The resulting computations are displayed in the RockWorks Utilities datasheet.
Import Fugro CPT Data	Imports lithology data from a Fugro Cone Penetrometer file into a lithology table. In the process, the program will concatenate similar intervals such that the lithology doesn't consist of hundreds of small intervals.
Export	These tools facilitate the export of lithology data from the Borehole Manager into other applications.

ASCII XYZG	Reads data from the current project's Lithology tabs and export the downhole data to an ASCII (text) XYZG file.
Lithology -> I-Data	Given a table of lithology and corresponding I-Data equivalencies, this program will create "synthetic" downhole I-Data.
Stratigraphy menu	Contains tools to visualize your stratigraphic data in a variety of ways. Units are color-coded based on the definitions in the Stratigraphy Types Table. Volume tools are available. Many gridding options are offered for surface interpolation.
Structural Elevations	Creates two-dimensional and three-dimensional diagrams that depict stratigraphy structural elevations.
2-Dimensional	Creates a 2D (flat) contour map representing the elevations of either the upper or lower surface of a selected stratigraphic unit.
3-Dimensional	Creates 3D images representing the upper or lower surface elevations of one or all stratigraphic unit(s) in the project.
One-Surface	Creates a 3D image representing the upper or lower surface elevations of a single stratigraphic unit in the project.
All-Surfaces	Creates 3D surface images of the upper surfaces of all stratigraphic units.
Stratigraphic Thicknesses	Generates 2D and 3D stratigraphic thickness diagrams of selected units.
2-Dimensional	Creates a 2D contour map representing the thickness of a selected stratigraphic unit or of multiple adjacent units.
3-Dimensional	Creates a 3D image that represents the thickness of one or more (adjacent) stratigraphic units.
Model	Interpolates grid models for the upper and lower surfaces of each of the project's stratigraphic units (or reads existing grid models) and creates a 3-dimensional diagram that illustrates stratigraphic layers using surfaces with side panels.
Profile	Interpolates grid models for the upper and lower surfaces of each of the project's stratigraphic units (or reads existing grid models), and displays these units in a 2D profile "sliced" between two points in the study area. Logs can be appended.
Section	RockWorks offers two stratigraphic cross-section tools, one based on surface models and one using simple, straight, hole-to-hole correlation lines.
Modeled	Interpolates grid models (or reads existing grid models) for the upper and lower surfaces of each of the project's stratigraphic

	units, and displays these units on multiple 2D cross section panels. The section can be drawn along any path through the study area; it is not necessary to align the panels to borehole locations. Strip logs can be appended.
Straight	Creates a 2D vertical profile of your project's stratigraphy, with multiple panels. Unlike a Modeled section, a Straight section must be drawn between boreholes, and it uses simple, straight lines to connect like formations in neighboring boreholes. No modeling is done.
Fence	RockWorks offers two stratigraphic fence diagram tools, one based on surface models and one using simple, straight, hole-to-hole correlation lines.
Modeled	Creates grid models (or reads existing grid models) for the upper and lower surfaces of each of the project's stratigraphic units, and display these units on multiple 3D cross section "fence" panels. You may request regular fence panel spacing, in a variety of configurations, or you can draw your own panels.
Straight	Creates a 3D fence diagram that illustrates stratigraphic layers. Fence panels are drawn between any user-specified borehole pairs. During the process of building the fence panels, the program will draw simpler linear correlations between wells.
Fence (ESRI-Format)	RockWorks contains two tools that create fence diagrams as 3-dimensional Shapefiles for subsequent display within ESRI software programs.
Modeled	Creates grid models (or reads existing grid models) for the upper and lower surfaces of each of the project's stratigraphic units and display these units on multiple 3D cross section "fence" panels. You may request regular fence panel spacing, in a variety of configurations, or you can draw your own panels. The completed fence diagram will be saved on disk in an ESRI Shapefile format.
Straight	Creates a 3D fence diagram that illustrates stratigraphic layers. Fence panels are drawn between any user-specified borehole pairs. During the process of building the fence panels, the program will draw simpler linear correlations between boreholes. The completed fence diagram will be saved on disk in an ESRI Shapefile format.
Surface Map	Creates a 2D map representing the stratigraphy where it intersects a designated surface, typically the ground topography. In other words, it creates a geological map based

	on downhole stratigraphic data. The process involves creating a stratigraphic model for the study area, storing it as a temporary solid model (MOD), and determining the intersection of the different formations with a user-specified surface model.
Plan Map	Extracts a horizontal, 2D slice of a stratigraphic model. The process involves creating a stratigraphic model for the study area, storing it as a temporary solid model (MOD), and then removing a horizontal slice from the model at the user-requested elevation.
Pick-Contacts	Use this interactive tool to determine depths to stratigraphic tops (and bases) from geophysical and/or lithology data. You can visualize existing lithology blocks or geophysical curves in a 2D display, and then point-and-click to pick the stratigraphic contacts. The contact depths are recorded in the project's Stratigraphy tabs.
Fill in Missing Stratigraphy	Inserts missing units into each borehole's Stratigraphy tab, setting them to zero thickness. This relies on the formation order defined in the Stratigraphy Types table and provides a means of adding control for surface interpolation.
Consolidate	Use this tool to lump adjacent stratigraphy depth intervals for the same formation as a single interval.
Volumetrics (Solid)	Reads a saved stratigraphic solid model (MOD file) and computes volume, mass, node numbers, or percent of each formation at user-specified elevation intervals. The resulting computations are displayed in the RockWorks Utilities datasheet.
Volumetrics (Grid)	Reads existing grid files representing a stratigraphy model, and computes volume or mass at user-specified elevation intervals. The resulting computations are displayed in the RockWorks Utilities datasheet.
Export	Export stratigraphy data to other applications.
ASCII XYZ	Exports stratigraphy depth, elevation, or thickness data for each borehole to an ASCII (Text) XYZ file.
Hanson Aggregates Stratigraphic Thickness Report	Creates a RockWorks Utilities datasheet that list the thicknesses of all stratigraphic units for all of the boreholes.
I-Data menu	Contains tools to interpolate a 3-dimensional solid model representing your downhole interval-sampled data (such as geochemistry) and display the model in a variety of ways.

Model	Interpolates a solid model (or reads an existing model) and displays the model as a 3D isosurface or voxel diagram. The data can be color-coded in a variety of ways and 3D striplogs can be appended automatically.
Profile	Interpolates a solid model (or reads an existing model) and displays the model as a 2D vertical profile, sliced anywhere in the study area. The profile layers can be color-coded in a variety of ways, and logs can be projected onto the profile plane.
Section	Interpolates a solid model (or reads an existing model) and displays the model as a 2D (flat) vertical profile composed of multiple panels, sliced anywhere in the study area. The section layers can be color-coded in a variety of ways, and logs can be appended to the panel junctions.
Fence	Interpolates a solid model (or reads an existing model) and displays the model as a 3D fence diagram. You may request regular panel spacing, in a variety of configurations, or you can draw your own panels. The data values can be color-coded in a variety of ways; 3D logs can be appended.
Surface Map	Interpolates a solid model (or reads an existing model) and creates a 2D map representing the model where it intersects a designated surface, typically the surface topography.
Plan Map	Interpolates a solid model (or reads an existing model) and displays a horizontal slice extracted from the model as a 2D contour or color map.
Statistics	Calculates statistics for a single column of I-Data measurements in the current project, for all enabled boreholes. The computations are displayed in a text window.
Histogram	Reads a single column of I-Data values from all enabled boreholes and determines the frequency or percentage of the total number of measurements for that variable that falls in each user-defined grouping or “cell.” These values are represented as a bar histogram plot.
Volumetrics	Performs a variety of "what-if" filtering operations and volume computing operations on an existing geochemical solid model. The input model can represent precious metal assays, contaminant concentrations, or any measurable component for which you wish to compute volume.
Export	Tools for exporting I-Data from the Borehole Manager to other formats.

Export XYZG	Exports one track of downhole I-data for the current/enabled/all boreholes to an ASCII (text) XYZG file or to the RockWorks Utilities datasheet.
Export CSV	Exports all tracks of I-data measurements for the current/enabled/all boreholes to an ASCII comma separated variable (CSV) file for use in Excel.
Extract	For a selected I-Data track this tool extracts the measurements that lie between two specified surfaces, and lists them in the RockWorks Utilities datasheet. This can be a means of extracting measurements that liewithin a specific stratigraphic unit.
P-Data menu	Contains tools to interpolate a 3-dimensional solid model representing your downhole point-sampled data (such as geophysical measurements) and display the model in a variety of ways.
Model	Interpolates a solid model (or reads an existing model) and displays the model as a 3D isosurface or voxel diagram. The data can be color-coded in a variety of ways and 3D striplogs can be appended automatically.
Profile	Interpolates a solid model (or reads an existing model) and displays the model as a 2D vertical profile, sliced anywhere in the study area. The profile layers can be color-coded in a variety of ways, and logs can be projected onto the profile plane.
Section	Interpolates a solid model (or reads an existing model) and displays the model as a 2D (flat) vertical profile composed of multiple panels, sliced anywhere in the study area. The section layers can be color-coded in a variety of ways, and logs can be appended to the panel junctions.
Fence	Interpolates a solid model (or reads an existing model) and displays the model as a 3D fence diagram. You may request regular panel spacing, in a variety of configurations, or you can draw your own panels. The data values can be color-coded in a variety of ways; 3D logs can be appended.
Surface Map	Interpolates a solid model (or reads an existing model) and creates a 2D map representing the model where it intersects a designated surface, typically the surface topography.
Plan Map	Interpolates a solid model (or reads an existing model) and displays a horizontal slice extracted from the model as a 2D contour or color map.

Statistics	Calculates statistics for a single column of P-Data measurements in the current project, for all enabled boreholes. The computations are displayed in a text window.
Histogram	Reads a single column of P-Data values from all enabled boreholes and determines the frequency or percentage of the total number of measurements for that variable that falls in each user-defined grouping or "cell." These values are represented as a bar histogram plot.
Import	Tools for importing data into the P-Data table
Colog File	Imports into the (P-Data tab of the current borehole the downhole geophysical data stored in a file supplied by Colog.
Fugro CPT Data	Imports quantitative downhole data from a Fugro CPT file into a P-Data table.
Analyze	Tools for analyzing P-Data.
Add Random	Adds random numbers to a p-data track.
Gamma Counts -> Uranium Grade	Reads Gamma measurements from a P-Data track and converts the data to uranium grade values in an I-Data track. Conversion constants can be uniform or pulled from custom fields in each borehole's Location tab.
Logarithm	Computes the logarithm of a given p-data column. Logarithmic conversions are useful when you want to show the variations within the low values despite high values that otherwise "squish" the curve when using the autoscale option.
Resample	Resamples a P-Data track, storing them in a new output track. Filters are also available. This can be helpful if your source data is sampled at too fine an interval to be practical for modeling or log display.
Fractures menu	Use the Fractures menu tools to analyze, display, and export downhole fracture data, entered into the Borehole Manager Fractures data tabs.
Model	Interpolates a solid model that represents distance to fractures across the study area, or reads an existing model, and creates a 3-dimensional isosurface or block diagram that illustrates proximities to your downhole fractures. The quantitative values can be color-coded in a variety of ways.
Profile	Interpolates a solid model, or reads an existing model, and creates a 2D vertical profile of fracture proximities, sliced anywhere in the study area. Logs can be projected onto the profile panel.

Section	Interpolates a solid model, or reads an existing model, and creates a 2D vertical profile of your downhole fracture proximities, with multiple panels. The section can be drawn along any path through the study area, and logs can be displayed at the section panel junctions.
Fence	Interpolates a solid model, or reads an existing model, and creates a 3D fence diagram that illustrates your downhole fracture proximities. You may request regular panel spacing, in a variety of configurations, or you can draw your own panels. Logs can be appended.
Surface Map	Creates a 2-dimensional map representing the fracture proximities along a designated surface, typically the surface topography, representing a surface fracture map based on downhole fracture data.
Plan Map	Extracts a horizontal slice of a new or existing solid model representing fracture proximities, at a user-specified elevation. The quantitative data can be color-coded in a variety of ways, and can be represented as a 2D or 3D map.
Rose Diagram	Reads downhole fracture bearing data for the current borehole and generates a rose diagram that represents fracture orientation and frequency.
Rose Diagram Map	Reads downhole fracture bearing data for all active boreholes and plots a rose diagram at each borehole location.
Stereonet	Reads fracture bearing and dip data for the current borehole and generates a stereonet diagram that represents fracture orientation and density.
Stereonet Map	Reads downhole fracture bearing and dip data for all active boreholes and plots a stereonet diagram at each borehole location
Export	These options are used to export downhole fracture data into other applications.
ASCII File	Computes the xyz coordinates at the downhole fracture midpoints and save this data within an ASCII file for subsequent use within other programs and/or incorporation into reports.
Utilities Datagrid	Compute the xyz coordinates at the downhole fracture midpoints, and save this data within the RockWorks Utilities datagrid for subsequent use within other programs (e.g. rose diagrams, stereonets, fracture modeling, etc.) and/or incorporation into reports.

Aquifers menu	Contains tools to interpolate and visualize your water level data in a variety of ways. These can be particularly useful when combined with other 2D and 3D diagrams of your project.
Model	Interpolates a grid model for the upper and lower surface of a single aquifer listed for a particular date or date range, and creates a 3-dimensional diagram that illustrates these surfaces, with side panels, in the color of your choice. 3D logs can be appended.
Profile	Iinterpolates grid models for the upper and lower surfaces of a single aquifer listed for a particular date or date range, and displays these in a 2D profile "sliced" between any two points in the study area. Striplogs can be projected onto the profile line.
Section	Interpolates grid models for the upper and lower surfaces of a single aquifer listed for a particular date or date range, and display these surfaces on multiple 2D cross section panels. Logs can be appended.
Fence	Interpolates grid models for the upper and lower surfaces of a single aquifer listed for a particular date or date range, and displays these surfaces on multiple 3D fence panels. 3D logs can be appended.
Plan	Creates a 2D contour map of the aquifer surface, base, or thickness.
Export	Export water level data to other applications.
ASCII XYZ File	Exports water level depth, elevation, or thickness data for each borehole for a selected date or date range to an ASCII (Text) XYZ file.
Vectors menu	Contains toosl for interpolating downhole vectors
Model	This program is designed to convert directional downhole data (stored within the Vectors table) into solid models that approximate the extents of the vectors. An example application is the generation of void geometries (cave models) based on downhole laser surveys.

RockWorks Utilities Menu Options

File menu	Contains options for opening, creating, importing row-and-column lists of data
Open Project	Allows you to browse to a different project folder

New	Create a new datasheet (ATD file). The program will display a window in which you can set up the column headings and column types for the datasheet.
Open	Opens an existing ATD file.
Recent	Displays a list of recently-accessed ATD files.
Save, **Save As**	Saves the current data under a new file name or existing file name, as an ATD or ASCII Tab-Delimited file. The column headings and column types are saved in the header section of this file.
Print	Prints the current ATD file
Import	Offers a variety of tools for importing data into the Utilities datasheet:
ASCII	Imports an existing ASCII text file of row and column data. The data will be imported using the current data layout
DBF	Imports the contents of a ".dbf" file created in a database manager such as DBase, FoxPro, etc. The data will be displayed in a new data sheet
DXF	Imports into the datasheet or into an external file the points from digitized contours maps in AutoCAD (or other CAD-type program) that have been saved in a DXF format
Garmin Txt	Imports the data from Garmin MapSource "txt" files . In the process, the program will convert the longitude/latitude positions to UTM (Universal Transverse Mercator) coordinates
Geonics EM38	Imports the data from a Geonics EM38 conductivity meter into the RockWorks Utilities datasheet.
GSM-19	Imports data from a GSM-19 gradiometer into the datasheet.
Laser-Atlanta	Imports data from Laser Atlanta survey devices. The import will generate a datasheet with ID, symbols, and X, Y, Z coordinates.
ModPath	Imports the data from an ModPath ASCII "Pathline File" into the datasheet.
NEIC	Imports earthquake data from the USGS National Earthquake Information Center into the datasheet. When used in conjunction with the Map / SpherePlot program, this utility can be used to view earthquake data as color-coded (by depth), size-coded (by magnitude) global maps. .
RockBase	Imports a "fixed-field" file used by the RockBase program (a member of the RockWorks DOS package).

SEG-P1 Imports SEG-P1 style shotpoint data into the datasheet. The program will read the selected SEG-P1 file and determine the points that lie on each seismic line.

WCS Imports data from a Tobin Well Coordinate Service (WCS) file into the datasheet.

XLS Imports the entirety of an XLS-format file from the Microsoft Excel program. The imported rows and columns will be placed in the active datasheet, starting at the row in which the cursor is currently placed.

Export Offers a variety of tools for exporting data from the Utilities datasheet:

ASCII Exports the current datasheet information to an ASCII text file.

DBF Exports the current datasheet information to a D-Base format file.

XLS Exports data from the current data sheet into an XLS-format file for use within the Microsoft Excel program. In order to use this export tool, you must have Microsoft Excel installed on your computer.

Transfer The Transfer options are used to transfer data between the Borehole Manager and the RockWorks Utilities datasheet.

Locations -> Borehole Manager Transfers borehole location information from the Utilities datasheet into the Borehole Manager database. Fields can be mapped to the Location table.

Stratigraphy -> Borehole Manager Transfers stratigraphic contact elevation data from the RockWorks Utilities datasheet back into the Borehole Manager database, restoring elevations to depths.

RockPlot2D Use this menu option to open a new RockPlot2D window. RockPlot2D is the 2-dimensional (flat) diagram viewing portion of RockWorks.

RockPlot3D Use this menu option to open a new RockPlot3D window. RockPlot3D is the interactive, 3-dimensional diagram viewing tool in RockWorks.

ReportWorks Opens a new ReportWorks window. This is a program for page layout of RockPlot2D images, raster graphics, with text and shape annotation, legends, and more.

Compile RCL File Use this menu option or toolbar button to read special "batch" commands listed in a RockWare Command Language (RCL) file and process them within RockWorks.

Close Select the File / Close command to terminate the RockWorks program.

Edit menu	Offers general data-editing options
Project Dimensions	Brings up the dimensions for the current project folder for viewing/editing.
Cut	Removes the currently-selected cell(s) and place the item(s) on the Clipboard.
Copy	Places a copy of the currently-selected cell(s) on the Clipboard.
Paste	Pastes data from the Clipboard starting at the currently active datasheet cell. Note: The Paste command will overwrite any data that is currently in the corresponding datasheet cells.
Delete	Deletes the datasheet cells that are currently highlighted.
Cut-All	Removes the contents of all cells in the current RockWorks Utilities datasheet and places the item(s) on the Clipboard.
Copy-All	Copies all of the contents of the current RockWorks Utilities datasheet and places the copy into the Clipboard.
Column	This submenu contains column-related datasheet operations.
Insert	Inserts a new column to the left of the currently active cell in the datasheet.
Delete	Deletes the column that contains the currently active cell in the datasheet.
Math	This submenu contains utilities that perform mathematical operations with column data in the RockWorks Utilities datasheet. Note: This is not an Excel "clone" - not by a huge stretch of the imagination. If you plan on doing lots of column math, we recommend that you copy or export your data to Excel, perform the desired operation, and then copy or import the data back to RockWorks.
Absolute	Computes absolute values of numbers within a data column (e.g. -1.4 -> 1.4) in the datasheet.
Column	Add, subtract, multiply, or divide the data within two datasheet columns in the datasheet. The output will be stored in a specified data column.
Constant	Add, subtract, multiply, or divide the data with a datasheet column in the datasheet by a user-specified constant. The output will be stored in a specified data column.
Merge	Combines the contents of two data columns into a single column in the datasheet. The user may specify a character that is used to separate the two combined items within the output column.

Increment Increments the values within a specified data column in the datasheet by a user-defined amount. This is useful when entering sample numbers or other information that is predictably incremental.

Combine These tools combine the textual contents of two columns in the datasheet. The output will be stored in a specified column.

Symbols RockWorks versions prior to RockWorks99 stored colors and symbols in separate columns in the datasheet. This tool combines them into a single column for greater compatibility with more recent versions.

Lines RockWorks versions prior to RockWorks99 stored colors and lines in separate columns in the datasheet. This utility combines them into a single column for greater compatibility with more recent versions.

Statistics Generates a quick statistical report on a single column in the datasheet. This tool is also available when you right-click on any datasheet column.

Filter Use the Filter tool to remove values in a datasheet column that exceed a user-declared maximum and/or fall below a minimum. This can be used to isolate a specific range of data values that you wish to view or model. This tool is also available when you right-click in any data column.

Fix Strips out spaces, tab characters, and commas from numeric values in a datasheet column.

Row This submenu contains row-related datasheet utilities.

Insert Inserts the specified number of blank rows above the specified row number. All subsequent rows will be moved down.

Delete Deletes the entire contents of the selected row(s), moving all subsequent rows upward.

Goto Locates a specific record within the datasheet.

First Positions the cursor at the first row within the datasheet.

Last Positions the cursor at the last row within the datasheet.

Specific Positions the cursor at a user-specified row within the datasheet.

Sort Sorts the contents of the current file displayed in the datasheet, based on the data column and sorting parameters you select. The sorted data will be displayed in the same data sheet.

Digitize The utilities within this sub-menu work as an interface between your digitizing tablet and your computer, permitting you to

	enter either X and Y point data or line endpoints directly into the data sheet. In order to use the digitizing capability of the program, you must have an electronic digitizer attached to your computer and a Windows "driver" for the digitizer installed on your computer. These drivers are supplied by the digitizer manufacturer or a 3rd party developer.
Points	Records XY coordinate data from a digitizing tablet directly into the datasheet.
Lines	Records lineation endpoint coordinates (X1, Y1 and X2, Y2) from a digitizing tablet into the datasheet.
Filter	Filters numeric data from the data sheet based on settings you enter for up to 5 data columns. The data that meets the filter requirements is loaded into a new, untitled data window that has the same data format as the original data file.
Refresh	Use the Refresh option to re-draw the contents of the current datasheet. This can be necessary from time to time if a change has been made in a column type (such as text to symbol) and the symbols are not being displayed.
View menu	Use this menu to query data, view summaries and XYZ computations, edit column headings, access other program windows, and more.
Columns	Used to change the headings of the data sheet columns and/or adjust the column types, in the RockWorks Utilities window. This information is stored in a "header" block of the RockWorks Utilities' ATD file.
Find Closest Point	Use this tool to enter a known X and Y coordinate and to locate the data record in the RockWorks Utilities window that is closest to that point.
Odd Numbered Row Color	Use this tool to select the color in which the odd numbered rows in the RockWorks Utilities window will be displayed.
Even Numbered Row Color	Use this tool to select the color in which the even numbered rows in the RockWorks Utilities window will be displayed.
Borehole Manager	Use this tool to access the Borehole Manager window in RockWorks. This has the same effect as clicking on the Borehole Manager tab along the left edge of the program window.
Tables	Use this tool to access the Tables window in RockWorks. This has the same effect as clicking on the Tables tab along the left edge of the program window.

My RockWorks	Use this tool to access the My RockWorks window in RockWorks. This has the same effect as clicking on the My RockWorks tab along the left edge of the program window.
Map menu	Contains a variety of point and contour- map making utilities
EZ-Map	Creates a quick map of XYZ data with contours based on triangulation when no grid is needed.
Grid-Based Map	Creates grid models of XYZ data, or reads an existing grid model, and generates a 2D map or 3D surface map.
3D Points	Reads an XYZ point listing and displays color-coded spheres in RockPlot3D. The horizontal and vertical radii of the spheres can be independently varied to produce oblates. These objects are useful for generating 3D scattergrams, as well as underground data points.
Multivariate Maps	Creates pie, starburst, spider or bar chart location maps, from XYZ1Z2Z3(etc.) data. Great for displaying relative percentages of variables.
Land Grid	Plots section maps and lease maps based on Range/Township/Section based on a RockWorks Land Grid table, or on the new LandBase PLSS database.
Shotpoints	Creates a map that illustrates shotpoint locations as read from data sheet
SpherePlot	Plots points, labels, polylines on a spherical or cylindrical display. Commonly used to display seismic data, volcanoes, ocean temperatures, and atmospheric temperatures.
Google Earth	Create placemark, polygon, and polyline maps for display in Google Earth using KMZ (Keyhole markup-language binary) files
Grid menu	Contains tools for manipulating grid models (GRD files)
Statistics	This **Grid** menu item offers a variety of grid model statistics tools:
Report	Reads a grid model (GRD) and generates a quick report of basic statistics.
Histogram	Creates a frequency histogram of the node values in an existing grid model, to show distribution of node values.
K-Gram	Creates an XY plot or scattergram of observed Z values versus computed node Z values for corresponding locations in an existing grid model.
Residuals	Computes the difference between observed Z values (listed in the datasheet) and computed Z values in an existing grid

model. The residuals will be listed in a column in the datasheet.

Multivariate Anomalies Provides an exploration tool when dealing with multiple spatial data sets. Given a list of grid models and weighting factors, the program performs creates a map/model that shows where all of the parameters are in agreement (e.g. all parameters anomalous).

Normalize Recomputes grid node values such that they range between a user specified min and max. Used for looking at relations between models that are in different units.

Standardize Recomputes the grid node values so they represent standard deviations from the mean. 0-1 background, 1-2 slightly anomalous, 2-3 moderately anomalous, 3-4 strongly anomalous, 4 extremely anomalous.

Math This **Grid** menu item contains utilities for performing mathematical operations with grid models (GRD files)

Grid & Grid Manipulates the nodes in one grid model by the corresponding nodes in another equally-dimensioned model. You may add, subtract, multiply, or divide node values, storing the results in a new grid model file. This could be used to compute isopach (thickness) models and grid differences.

Grid & Constant Manipulates the nodes in a grid model by a constant. You may add, subtract, multiply, or divide the node values by the constant, storing the results in a new grid file.

Density Conversion Translates grid node values representing thickness, to density values using a constant.

Absolute Value Translates grid node values to positive values, storing results in a new grid file.

Resample Creates a new grid based on the values in an existing grid and new grid dimensions entered by the user. Helpful for making high-resolution DEM models comply with current project dimensions.

Filters This **Grid** menu item contains filtering tools for GRD files

Boolean Compares nodes in an existing grid model to a user-defined range, storing matching nodes to “1” (true) and all others to “0” (false). Great for comparing multiple models or creating exploration models.

Limit Used to constrain an existing grid model with another grid model, such as a stratigraphic surface model with a ground surface model. Either high or low values can be constrained.

Minimum Area Reads either a Boolean or a conventional grid model and evaluate contiguous cells that exceed a user-defined area. If the area of a group of contiguous cells is less than a user-defined threshold, the nodes will be set to zero. This provides a means for eliminating exploration targets that are too small.

Polygon Clip Reads an existing grid model and sets the grid nodes inside or outside of a polygon to either a user specified value or the values defined within another grid mode. Often used to set nodes outside the polygon to null.

Range Reads an existing grid model and sets the Z values above or below user-defined threshold to a user-specified value.

Round Rounds the node values in an existing grid model to a user-defined interval. Can be used to preview a region after benching the topography.

Smooth Used to average adjacent cells to reduce the lateral variability within a surface.

Edit Used to edit the node values stored in a RockWorks grid model, or to create from scratch a new grid with user declared dimensions and node values. The Grid Editor is used to modify node "Z" values only. It cannot be used to modify the X Y location coordinates of the nodes themselves.

Directional Analyses This **Grid** menu item contains tools for computing slope and direction of GRD files and generating maps:

Slope/Aspect Analysis Computes the changes in Z-values (elevations, concentrations, etc.) between neighboring nodes in an existing grid file, and stores these in up to three new grid files:
> A slope grid which contains the change (or slope) between node Z-values, expressed in degrees, percent, or radians.
> An aspect grid, which contains the direction of the slope, expressed in azimuth degrees.
> A second-derivative grid, which contains the change in slope (the slope of the slope grid) to illustrate bends.

Directional Maps Contains options for different directional map types:

Up/Downgradient Vectors Reads an existing grid model and displays a small arrow at each node, pointing down-slope or up-slope in the direction of the slope as modeled in the slope and aspect grid models. You may request that the arrows be scaled proportionally to the slope value (steepness).

Strike and Dip Maps Displays at each node a small line in the direction of the strike, with a smaller line perpendicular to this in the direction

of the dip. Locations with zero dip angle are noted with closed circle symbols.

Flow Maps Reads an existing grid model and illustrates the high-to-low pathway using lines.

3D Flow Diagrams Creates a simulated three-dimensional drainage net based on an existing surface grid model.

Movement Analysis Reads X, Y, Z and time data and determines the direction, inclination, distance, and velocity.

Trend Surface Analysis This **Grid** menu option contains tools for performing Trend Surface analysis

Report Performs a trend surface analysis on a selected Z-value column in the data sheet and lists the correlation and residuals for first through sixth order polynomials in a report. The completed report is loaded into a RockWare text window.

Residuals Performs a trend surface analysis on a selected z-value column and computes the residuals for a selected polynomial order, representing the difference between observed z-values and trend z-values. The residuals are stored in a data sheet column of the user's choice.

Initialize Creates a new grid model that represents a flat plane with a user-defined elevation or a dipping plane based on a user defined orientation. If the plane is dipping, the user may define the xyz coordinates for a point that the dipping plane will intersect.

Morph Generates a series of transitional grids / and/or contour-map images given two "end-member" grids. The user can specify the graphic format for the output maps, and they are then loaded into the RockWorks "picshow" application.

Import Reads an existing set of gridded data stored in one of the accepted formats and translate the data into a RockWorks grid file format.

ASCII: ASCII grid files consist of a list of space-delimited xyz values in which each line contains one node, also referred to as "Text" format.

Bitmap: Imports BMP or JPG images and stores them as grid models.

Digital Elevation Model (DEM): Imports Canadian Government, USGS 30-Meter, or USGS 3 Arc Second DEM formats.

GXF: This represents GXF (Grid eXchange Files) output from the Geosoft program. This program does not import "compressed" GXF grid models.

ESRI ASCIIGRID: Imports a grid model from an ESRI GIS (r) program that has been saved in an ASCII format.

RockWorks7: These grid models are binary files that were created by the last DOS version of RockWorks.

Surfer ASCII or Binary: RockWorks can import GS Binary or GS ASCII grid models from Surfer 6, 7, and 8, as well as Binary grids from Surfer 7 and 8.

Export Exports the data contained in a RockWorks grid model to another file format. It offers grid export to ten different formats, with a variety of options:

ASCII XYZ: X and Y node locations and Z values are listed in three columns, separated by the character of your choice, at the decimal precision you select, with or without a header.

ASCII Matrix: The Z-values only of the grid file are listed in rows and columns, with the number of entries corresponding to the numbers of nodes horizontally and vertically in the grid file. The Z-values are listed at the decimal precision you select.

AutoCAD DXF Matrix: These ASCII files can be read into any software application that reads files in a DXF format. They will appear as a three-dimensional mesh surface, with line color, layer number, vertical exaggeration, and other parameters user-selected.

Geosoft GXF: GXF (Grid eXchange Files) are an ASCII grid format read by Geosoft software.

ESRI ASCIIGRID: Export the RockWorks grid to an ASCII grid file that's importable into ESRI GIS programs for contouring and other spatial analysis.

Ohio Automation ENZ: X and Y node locations and Z values are listed in three columns in an ASCII format, with columns separated by commas. The node order is the same as that listed for the ASCII XYZ, above.

RockWorks7: This grid file format is read by the RockWorks version 7 program for DOS, published by RockWare.

RockWare RTM: The RockWare Terrain Model (RTM) format is a binary grid file format originally designed as a compact method for shipping Digital Elevation Model (DEM) data.

Surfer: Both ASCII and binary formats are available for Surfer grid files.

VistaPro: This is a binary grid format read by VistaPro, for loading into that program as DEM data.

LidarXYZ / Grid Imports Lidar ASCII data and converts it to a GRD file.

Grid -> Profile	Reads an existing grid model and creates a simple 2D line profile drawing along a user-defined cut.
Grid -> Fence	Reads an existing grid model and creates a 3d line profile, along a single- or multi-segmented user cut.
Grid -> Stratigraphic Fence	Creates a 3D stratigraphic fence diagram based on a list of grid models representing the upper and lower formation surfaces that already exist on your computer. This is typically used to build fences after manipulating the grid models, and it offers an erosional cutoff.
Grid ->Stratigraphic Model	Creates a 3D stratigraphic model based on a list of grid models representing the upper and lower formation surfaces that already exist on your computer.
Grid-> 3D Stack	Reads multiple, existing grid models and creates flat, stacked, color-coded surfaces in 3D space for the purpose of visual comparisons. T
Grids-> Stratigraphic Logs	Given a list of grid models, this program will define (or redefine) the contacts within existing stratigraphic logs based on the contents of a list of one or more stratigraphic surface models. Sample applications include interpolating elevations for missing contacts within borehole files (e.g. lost circulation intervals), and estimating what a log might look like before the borehole is drilled (i.e. prediction).
Grids-> Solid Model	Create a solid model based on a list of grid models. All of the nodes between two surface models will be set to a user-defined g-value. By creating a list of these surface models (aka "pairs"), a layered model can be produced. This program is similar to the Grids -> Stratigraphic Model except that this program creates a numeric solid model (that can be subsequently manipulated) whereas the Grids -> Stratigraphic Model program just creates a diagram.
Solid menu	Contains tools for generating and manipulatingsolid models (MOD files)
Model	Creates a solid model of XYZG data that is listed in the main datasheet or in separate XYZG text file.
Profile	Reads an existing solid model file and creates a vertical profile slice that is displayed in RockPlot2D.
Section	Reads an existing solid model file and creates multiple, connected vertical profile slices that are displayed in RockPlot2D.

Fence	Reads an existing solid model file and creates multiple vertical profile slices that are displayed as a "fence diagram" in RockPlot3D.
Plan	Creates a single horizontal "slice" through an existing solid model file and displays it in RockPlot2D.
Statistics	This Solid menu item offers a variety of solid model statistics:
Report	Creates a report listing summary information for an existing MOD file.
Histogram	Creates a frequency histogram of the node values in an existing MOD file.
Krajewskigram	Creates an XY plot or scattergram of observed G values versus computed node G values for corresponding locations in an existing solid model.
Residuals	Computes the difference between observed G values (listed in the datasheet) and computed G values in an existing solid model. The residuals will be listed in a column in the datasheet.
Math	Offers mathematical operations for solid model MOD files.
Model & Constant	Creates a new MOD file by adding, subtracting, multiplying, or dividing the node values in an existing MOD file by a constant that is defined by the user.
Model & Model	Creates a new MOD file by adding, subtracting, multiplying, or dividing the node values in two existing solid models.
Resample	Creates a new solid model based on the values in an existing solid model and new model dimensions entered by the user.
Filter	This menu offers solid model filtering operations:
Distance Filter	Filters an existing solid model based on the nodes' distance from the drill holes. All nodes that lie beyond the distance cutoff will be set to zero. This can be used to remove low-confidence areas from a solid model.
Grid	Used to adjust the voxel values in a solid model based on their location above or below one reference grid model, or above, between, or below two reference grid models. This is a good way to assert stratigraphic surface constraints on a solid model.
Polygon Clip	Reads a polygon table, and sets a solid model's nodes that lie either inside or outside a vertical projection of the polygon to a user-specified value or null.
Range Filter	Deletes high or low G-values in a solid model file and reassigns them a user specified constant..

Rounding Filter Rounds the model G-values to the closest user-defined G value increment.

Smooth Smooths an existing solid model and averages the G-values based on a user declared "filter" size.

Tube Filter Given a list of xyz coordinates that represent the axes of tubes (e.g. mine workings, tunnels, etc.), the program will either set all nodes for a designated solid model outside or inside the tubes to a null value.

Boolean Operations Offers tools for converting real number MOD files to Boolean (true/false) models based on user criteria.

Boolean Conversion Converts a real number solid model file to a Boolean (true/false) model. In this process the G-values of nodes are set to "1" if their original G-value falls within a user-specified range, and to a "0" of the G-values do not.

Min Ore Zone Thickness Used to specify a minimum thickness for any individual ore zone to be included in the output model and computations. This is a means of discarding non-economic areas from totals.

Min Total Ore Thickness Used to specify a minimum thickness for the combined total ore zone to be included in output model and computations. This is also a means of discarding non-economic areas from the totals.

Max Waste Thickness Used to remove small pockets of "non-ore" material from surrounding "ore" blocks, translating them to "ore" classification and including them in output solid model for future calculations (same as interbed filter within the Volume/ 3D Volumetrics option.)

Stripping Ratio Filters a Boolean solid model based on the ratio between the thickness of the overburden ("waste") and the thickness of the zone of interest ("ore"). Several methods of computing the stripping ratio are offered, based on the individual ore zones or total ore zones.

Density Conversions Used to enter multiplier for individual Boolean voxels so that the program can compute total mass as well as total volume.

Convert Offers Grid <-> Solid model conversion tools:

Solid -> Grid Creates a grid model in which the z-value represents either the highest, lowest, average, or sum of corresponding G value within a solid model.

Ore Thickness->Grid Converts a Boolean solid model file representing "ore" versus "not-ore" into a 2D grid file that represents total ore thickness.

Overburden Thickness->Grid Converts a Boolean solid model file representing "ore" versus "not-ore" into a 2D grid file that represents total overburden thickness.

Extract Grid from Model Creates a 2D grid file from an existing real number or Boolean solid model file. The grid file can be extracted from any horizontal (constant Z) or vertical (constant Y or X) layer in the original solid model.

Insert Grid into Model Inserts a 2D grid file "slice" into an existing real number or Boolean solid model file, replacing the existing model voxel values with the grid node values. The grid file can be inserted into any horizontal or vertical layer in the original solid model.

Edit	Used to edit the contents of real number or Boolean solid model file, one "slice" at a time. The slice you specify will be loaded into the Grid Editor for viewing and Editing.
Fracture Discs -> Solid	Creates a solid model based on a list of "discs" loaded into the Utilities datasheet. The program assigns voxel values based on the distance between a voxel node and the closest point on the closest disc, meant to represent fractures.
Morph	Creates one or more intermediate solid models between two existing solid models by creating a series of weighted averages of the beginning and ending models. The models are then loaded into the RockPlot3D Viewer.
Import	Reads regularly-spaced xyzg data from a text file and converts it to a RockWorks solid model.
Export	Exports a RockWorks solid model file to another format, for use in another software application. The following exports are offered: ASCII XYZG, NOeSYS, Slicer Dicer, Voxel Analyst
Initialize	Creates a "blank" solid model file using user-declared model dimensions, node spacing, and default G values.
Volumetrics menu	Generates volume reports from grid models, solid models, or thickness data
EZ Volume	Computes the volume and mass of a stratigraphic unit based on thickness values and a density conversion factor. Can also be used to compute the volume of stockpile by substituting the point heights for the thicknesses. Computations are made by using the Delaunay triangulation method.
2D (Grid Model)	Computes the volume of a stratigraphic unit based on a grid generated from XY and thickness values, among other parameters.

Extract Solid	Reads an existing solid model (such as soil chemistry or lithology type), determines the volume of a pit that would be required to extract the portions of the solid model that fall within a specified range (e.g. contaminated soil or selected lithotype). The output is a report that lists the pit and contaminant volumes and stripping ratios, a 2D diagram illustrating the pit elevations, and/or a 3D diagram showing the filtered solid and pit elevations.
Grade-> GT (Grade Thickness)	Given a solid model that contains grade values, this tool will produce a grade-thickness grid and contour map in which the contours represent the grade multiplied by the thickness.
Hydrology menu	Contains tools for generating drawdown, flowline, and hydrograph diagrams
Drawdown (1 well)	Calculates water-level drawdown for a single well using the Theis non-equilibrium equation. Data for a single well is entered directly into the program dialog box.
Drawdown Surface	Generates a potentiometric surface model based on pumping and/or injection wells using the Theis non-equilibrium equation. Data from multiple wells is read from the main data sheet.
Flowlines	This tool plots ModPath-style particle paths as 3-dimensional tubes
Hydrograph	Reads listings of water level and precipitation measurements over time and creates a HydroGraph diagram that illustrates their relations.
Hydrochemisty menu	Contains tools for analyzing hydrochemistry (ion) data
Durov Diagram	Reads a listing of ion concentrations from the datasheet and generates a Durov diagram that shows relative ion concentrations in milliequivalents per liter.
Ion Balance	Reads a listing of ion concentrations from the datasheet and computes cation:anion ratio for each sample, in milli-equivalents per liter. The computations are stored in a column in the datasheet. RockWorks uses the following equation for the ion balance: ((cations - anions) / (cations + anions)) x 100
Piper Diagram	Reads a listing of ion concentrations from the datasheet and creates a Piper diagram that shows relative ion concentrations in milliequivalents per liter.

Stiff Diagram	Reads a listing of ion concentrations from the datasheet and creates a Stiff diagram that shows relative ion concentrations in milliequivalents per liter.
Stiff Map	Reads a listing of sample locations and ion concentrations from the datasheet and creates a map with individual Stiff diagrams at their respective map locations.
Total Dissolved Solids	Reads ion concentrations from the datasheet and compute total dissolved solids for each sample. The computations are stored in a column in the datasheet. Total dissolved solids represent the sum of all "declared" ions, as listed in the Data Input Columns, in the parts per million (or milligrams per liter) units read from the datasheet.
Linears menu	Contains tools for 2D orientation analysis
Arrow Map	Creates a map in which lineations are represented with arrow plotted from the beginning X.Y Coordinates to the ending coordinate pair.
Lineation Gridding	Reads lineation data (in X1, Y1, X2, Y2 endpoint coordinate format), and creates a grid file that models the lineation frequency, cumulative lengths, and/or intersections, with a variety of weighting options. The resulting grid model can be illustrated as a 2D or 3D map.
Lineation Map	Used to create a map of lineations from line endpoint data.
Lineation Properties	Computes the bearing, length, and/or midpoint of lineations listed in the main datasheet as X1 Y1 X2 Y2 line endpoint coordinates. The computed values are stored in separate columns in the main datasheet.
Rose Diagram	This utility reads either bearing or line endpoint data and generates a directional diagram that depicts the orientations of the linear features.
Import	Used to import lineation endpoint data from a DXF file, storing the endpoint coordinates in the main RockWorks data sheet.
Planes menu	Contains tools for 3D orientation analysis
3 Points->Planes / Single	Computes strike and dip based on three points and plots a surface as a contour map. The X,Y,Z points are typed into the program window.
3 Points->Planes / Multiple	Given a list of xyz coordinates for three points along a series of planes, this program computes the dip direction (or strike) and dip angle for planes that pass through these points. The output is stored within two new datasheet columns

Beta Intersections	Reads a listing of planar orientations from the RockWorks data sheet and calculates the lineations resulting from the intersections of all of the planes in the file. The linear values will be stored in an ASCII text file that can be displayed in the RockWorks text editor when completed
Beta Pairs	Reasd the strike and dip of pairs of planes and calculates the lineations resulting from their intersections.
Rotate Planes	Rotates 3D features by a specified amount, and lists the resulting strike and dip (or dip direction, dip angle) values in tow new columns of your data sheet.
Stereonet Diagram	Reads planar, linear, or rake data from the data sheet, and displays the orientation of these features on a stereonet diagram using points and great circles. Optional gridding is available to display point density with line or color-filled contours.
Strike -> Dip Direction	Used to determine the direction, inclination, distance, and velocity for X, Y, Z and time data. Translates azimuth bearings representing strike to dip direction. This permits you to change the format of your data from "right hand rule" to "dip direction"
Strike & Dip Map	Plots a strike and dip map based on X and Y coordinates, strike, dip, and color data from the data sheet.
Import /Polylines->Planes	Reads xyz polyline coordinates from an ASCII file and computes the orientations of planes that pass through the polyline vertices. It is designed for applications in which the user has xyz coordinates that represent the intersections between fractures or contacts and surface topography. By computing the orientations of planes that pass through these points, it is possible to analyze and/or visualize the relative positions and orientations of these structures
Stats menu	Contains tools for analyzing & graphing one, two, or three sets of data
Univariate	Computes a variety of statistical parameters based on the data within a user-defined column and save this data with a textual report.
Histogram	Reads a designated column of data from the RockWorks data sheet and determines the frequency or percentage of the total number of measurements for that variable that falls in each user-defined grouping. Options include single or multiple graphs.

Scattergram	Used to plot the data within a designated column against the data within another column. A variety of interpolation techniques are available.
Ternary Diagram	Generates trilinear diagrams based on three columns of data. Options include the ability to contour point densities, unique symbols and annotation control with classification overlays.
Normalize	Reads a single column of values from a RockWorks data sheet and normalizes the data values so that they range between two user-specified values. Normalized values are written to the current datasheet.
Standardize	Reads a single column of values from a RockWorks data sheet and calculates the mean and the deviation of each sample value relative to the mean. These are written to the current datasheet.
Random/ Complete	Randomly generates numbers within the user-defined parameters and store them in a selected column in the data sheet.
Random/Normal	Randomly generate numbers for a normal distribution and store them in the selected column in the data sheet.
Point Distances	Generates a basic statistical report that lists distances, azimuth and inclinations between a list of xyz points in the RockWorks Utilities
Survey menu	Contains ground and downhole survey tools
Bearing Distance	Converts survey data, entered in bearing and distance from reference stations, to XYZ coordinates for display in a new data sheet, and/or to create a plottable map that illustrates the survey stations and/or transect lines with a variety of labeling options. XYZ file, 2D Map, and 3D Diagram options.
Triangulation	Used to convert triangulation survey data to XYZ coordinates for display in the data sheet. This program requires that two or more stations have known X, Y, Z coordinates from which other coordinates can be computed.
Setup XY Stations	Used to create a new set of X.Y coordinates based on single user-entered coordinates, a known grid-based station arrangement and user-entered spacing.
Interpolate Points Along a Line	Creates a new set of X, Y coordinates based on beginning and ending coordinates of a line, and point spacing along that line.
Drill Hole Survey	Reads depths, bearing, and inclinations from a downhole survey table, and computes XYZ coordinates at user-specified

	intervals down the borehole. Offers a 2D and 3D diagram view of the deviated borehole.
Coords menu	Contains coordinate translation tools
Lon/Lat->UTM	Converts X,Y location coordinates from a long & lat format (in decimal degrees) to a Universal Transverse Mercator (UTM) format in meters or feet. A variety of projections are available.
UTM-> Long/Lat	Converts UTM XY coordinates (in feet or meters) to long/lat coordinates (in decimal degrees). A variety of projections are available.
Lon/Lat/Offset -> UTM	Converts Pennsylvania-style location descriptions to Cartesian (XY) coordinates.
Decimal -> Degrees/Minute/Seconds	Translates decimal degrees into degree/minute/second format. The input degree, minute, and second coordinates must occupy three separate columns in the RockWorks Utilities data sheet. The output decimal degree values will be stored in user-selected column.
Degrees/Minute/Seconds -> Decimal	Translates D/M/S coordinates into Decimal Degrees.
Polar -> XY	Translates location coordinates listed in a polar coordinate format (bearing and distance) to X,Y coordinates in a Cartesian coordinate format, assuming a fixed reference point. The resulting coordinates are stored in two columns in the main datasheet.
XY -> Polar	Translates X,Y locations in a Cartesian coordinate format to a polar coordinate format (bearing and distance) assuming a fixed reference point. The resulting coordinates are stored in two columns in the main datasheet.
XYZ -> Polar	Converts a list of XYZ coordinates into a borehole-style list of polar coordinates (i.e. distance, bearing, inclination). This program is intended for occasions when you might need to treat a list of points as a borehole (i.e. converting the data into the Borehole Manager orientation table).
Azimuth-> Quadrant	The program will translate the decimal-style azimuth bearings into quadrant-style bearings and store them in the selected column in the datasheet.
Quadrant-> Azimuth	Translates quadrant-style bearings (i.e. S45E) into decimal-style azimuth bearings (i.e. 135).
Rescale XY Data	Rescales X,Y location coordinates by a user-declared real number value. Coordinates may be rescaled differently in the Y and Y directions.

Rotate XY Data Rotates X, Y location coordinates by a user-declared amount around a user declared “pivot” point.

Shift XY Data Shifts the X, Y location coordinates by a user-declare amount in both the X and Y directions.

Jeffersonian Points -> Cartesian Converts Jeffersonian style point (well) locations to Cartesian coordinates. The translation is based on the RockWare Landbase or on a “land grid table” you have already created using a commercial land grid data set or an “idealized” land grid.

Jeffersonian Polygons -> Cartesian Converts Jeffersonian style 4-cornered polygon descriptions (leases) to Cartesian coordinates. The translation is based on the RockWare Landbase or on a “land grid table” you have already created using a commercial land grid data set or an “idealized” land grid.

Dates -> Star Dates Translates dates listed as month/year, month/day/year, or day/month/year into a decimal-style stardate. Most typically this is used if you wish to plot date-dependent data along an axis of an XY plot, and the application requires that dates be entered in decimal format.

Time Merge Adds X,Y coordinates (e.g. UTM Eastings & Northings) to datasets that only have a "timestamp". The coordinates for a given event (e.g. a geophysical measurement) are established by locating the preceding and succeeding times within a designated GPS file and interpolating between these two "known" points.

Grafix menu Contains tools for creating and manipulating raster and RockWorks graphics

2D Utilities Offers tools for manipulating RockPlot2D graphics files (*.RK6). These options are also available within RockPlot2D itself.

- **Append** Combines the contents of two RockPlot2D files (*.RK6), and to save the results under a new RK6 file name
- **Clip** Extracts from an existing map or diagram, created in RockPlot2D and saved as an RK6 file, all of the contents that lie within a user-declared rectangular area. The clipped image is displayed in a new, untitled RockPlot2D window.
- **Montage** Rescales (if necessary) and combines multiple RockPlot2D plot files (*.RK6) into a single "montage," using coordinate information that you enter into a table. The new image containing the combined plots is displayed in a new, untitled RockPlot2D window.

Rescale Rescales X,Y location coordinates in a graphic image using either of these methods: (1) Using new origin coordinates and scaling multipliers. (Coordinates may be rescaled differently in the X and the Y directions.) (2) Using new coordinates entered for one or more boundary edges.

Import Imports AGL (RockWorks ASCII Graphics Language), DXF, and Shape Files into an RK6 format for display in RockPlot2D.

Export Exports an existing RK6 file into the following formats: BMP, DXF, EMF, JPG, KMZ (Google Earth), PNG, RockPlot3D, TIFF, and WMF.

3D Utilities This menu generates a variety of 3D diagrams:

Discs Plots oriented discs in three dimensional space. These discs may represent fractures or other oriented planar features

Images Displays raster images (BMP, JPEG, TIFF, WMF, EMF, PNG, TGA, and PCX) in 3D.

Cube Displays bitmaps on cube faces.

Float Assigns a raster image XYZ coordinates for each corner for display in a RockPlot3D window. This floating image could be appended to another 3D image.

Drape Used to 3-dimensionalize a raster image by "draping" it over an existing grid model. The new image will be displayed in a RockPlot3D window, for display alone or with another 3D image.

Panels / **Vertical Panels** or **Horizontal Panels** Used to read a list of raster image file names and corner XYZ coordinates from the main data sheet for display in RockPlot3D.

Oriented Objects Reads location and orientation information from the main data sheet, and displays these as 3D oriented arrows in the RockPlot3D window.

Perimeter This program reads a list of x/y coordinates and creates a series of vertical panels that may be used to show a project area perimeter within a 3D diagram.

Storage Tanks / **Horizontal** or **Vertical** Used to read location elevation, radius and color data from the datasheet and draw 3D cylindrical tanks at those location for display in RockPlot3D. Use this to display underground or surface tanks with your 3D images. The tanks can be oriented vertically or horizontally.

Surface Objects Creates 3D building, roads, other objects based on a text file.

Triangles	Plots a series of colored triangles in 3-D space. The input consists of a datasheet which contains the coordinates for each triangle vertex.
Tubes	Reads X1Y1Z1, X2Y2Z2 coordinates from the main data sheet, and displays these as oriented tubes in the RockPlot3D window.
Urchingram	Reads a listing of azimuth bearings, inclination angles and lengths, and display them as arrows or tubes in 3D as a single "urchin" shaped object.
Prismgram	Reads a listing of azimuth bearings, inclination angles and lengths, and display them as prisms in 3D as a single object.
Append	Combines two RockPlot3D XML files into a single diagram. This tool has the same function as the File / Append tool within RockPlot3D itself.
Montage	Combines multiple RockPlot3D files (*.XML) into a single XML file, based on a list of XML files in the Utilities worksheet.
Reference Cage	Use this tool to generate a 3D "reference cage" noting X, Y, and elevation coordinates. This is the same type of cage available within other RockWorks menus, but is generated on its own.
Images	This **Grafix** menu offers tools for manipulating raster images (BMP, JPEG, TIFF, WMF, EMF, PNG, TGA, and PCX formats)
Animated GIF	Creats an animated GIF file (suitable for inclusion within web pages) based on a list of images, such as the list generated by the Grid / Morph program.
Append Raster Image	Appends a raster image to an existing RK6 file based on X and Y coordinates entered by the users.
Digitize from Bitmap	Imports a bitmap, calibrates it to global coordinates, and digitize points, lines, polylines, and polygons. As the items are selected, the global coordinates are stored within and editable data window along the right side of the screen. This data may then be copied into other applications
PicShow	Reads a list of names of bitmap images from the main RockWorks data sheet, and display them in order, with an adjustable delay between frames. The PicShow can run once or be continually looped to repeat the display list.
Raster –> RKW	Converts a raster image to a RockPlot RK6 file. This can be used to add aerial photos to your maps or raster well logs or

	core pictures to your strip logs, cross sections and fence diagrams. For very large images you may want to resize them to save disk space and for better viewing quality using the Raster Conversion utility
Raster Conversions	Converts raster information between a variety of formats (e.g. TIFF to JPG)
Rectify Image	Rectifies (shifts and rotates) an image based on three points, and then clips it based on the current Project Dimensions, or dimensions entered by the user.
Tools menu	Contains a variety of program configuration options.
Main Menu Configuration Wizard	Walks the user through a series of program configuration screens.
General Preferences	Used to establish some general operational settings for the program.
Import Menu Settings	Allows the user to import a "snapshot" of menu settings that were saved previously.
Export Menu Settings	Allows the user to export a "snapshot" of menu settings that can later be imported.
Restore Menu Settings	Restors the menu settings to factory default configuration.
Change Licensing	Launches the RockWorks licensing program, where you can remove the licensing from the current computer, or change the license type (Single User to Network for example).
Network Users	Displays users currently logged into the network license manager.
Widgets menu	Contains a variety of miscellaneous tools
Area / Volume	Performs geometric calculations such as surface areas, volumes, and side lengths of various geometric shapes and solids.
Colors	Two tools: One returns the Windows color number (typically used in RockWorks) for a color selected from a palette. The other converts Red/Green/Blue color numbers to Windows color numbers, typically used in RockWorks
Finance	Used to calculate cost and profit breakdown, lease analysis, and amortization on loans by changing various factors within the utility equations. **Break-even Analysis** determines when a project has paid for itself; it can also estimate profits and losses. **Lease Analysis** calculates square footage rates, monthly rent, & annual rent based on any combination of the other variables.

Loan Analysis (amortization) determines various loan-related items: when a loan will be paid off, total amount paid, etc.

Geological Time Chart An interactive program designed to show the duration, ages, and major events of various geological time periods.

Igneous Rock Identification Used to identify igneous rocks by displaying a series of questions about the rock characteristics, and offering a classification based on your responses.

Periodic Table Used to retrieve information about various elements by pointing at the elemental symbol on the table and pressing the mouse button.

Trigonometry Calculator Performs various trigonometric calculations, such as apparent dip or true dip, drilled thickness, strike and dip from 3 points, and more.

Unit Conversions Used to convert measurement units (length, area, pressure, velocity, etc.) By entering a single value in a particular measurement system, you can create a table displaying an equal measurement in other units

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